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THE GIANT PANDA

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1930

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HAWTHORNE DANIEL
Editor

A. KATHERINE BERGER
Associate Editor

CONTENTS

THE GIANT PANDA ..... *Cover*
From a Painting by Arthur A. Jansson (See Note, page 112)

ALASKA IN PLEISTOCENE TIMES ..... *Frontispiece*
A Reconstruction Painted by Mrs. E. Rungius Fulda

THE SEARCH FOR THE GIANT PANDA ..... KERMIT ROOSEVELT 3
The Field Museum Obtains a Specimen of the Rare Beishung

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE
GERTRUDE SANFORD AND SIDNEY LEGENDRE 17
The First of Two Articles Describing a Hunt for Abyssinian Nyala

THE UNIVERSAL APPEAL OF THE AMERICAN INDIAN ..... CLARK WISSLER 33
Types of Indian Life in North America

SEA SIRENS ..... GEORGE GAYLORD SIMPSON 41
The Strange Mammals Responsible for the Ancient Ideas of Mermaids

THE GRASS TRAILS OF EAST AFRICA ..... LEONARD KEPHART 48
An Expedition of the United States Department of Agriculture

WHAT PRODUCES SPECIES? ..... G. KINGSLEY NOBLE 60
Recent Laboratory and Field Work Give a Solution to a Problem of Long Standing

ALASKA'S FROZEN FAUNA ..... CHILDS FRICK 71
Finding and Preserving the Remains of Mammals Frozen in the Northern Tundra

THE LION OF INDIA ..... ARTHUR S. VERNAY 81
An Account of One Phase of the Vernay-Faunthorpe Expeditions

WILD LIFE IN DOMINICA ..... PAUL GRISWOLD HOWES 90
An Outline of the Interesting Fauna of a West Indian Island

AMERICAN MUSEUM EXPEDITIONS AND NOTES 104

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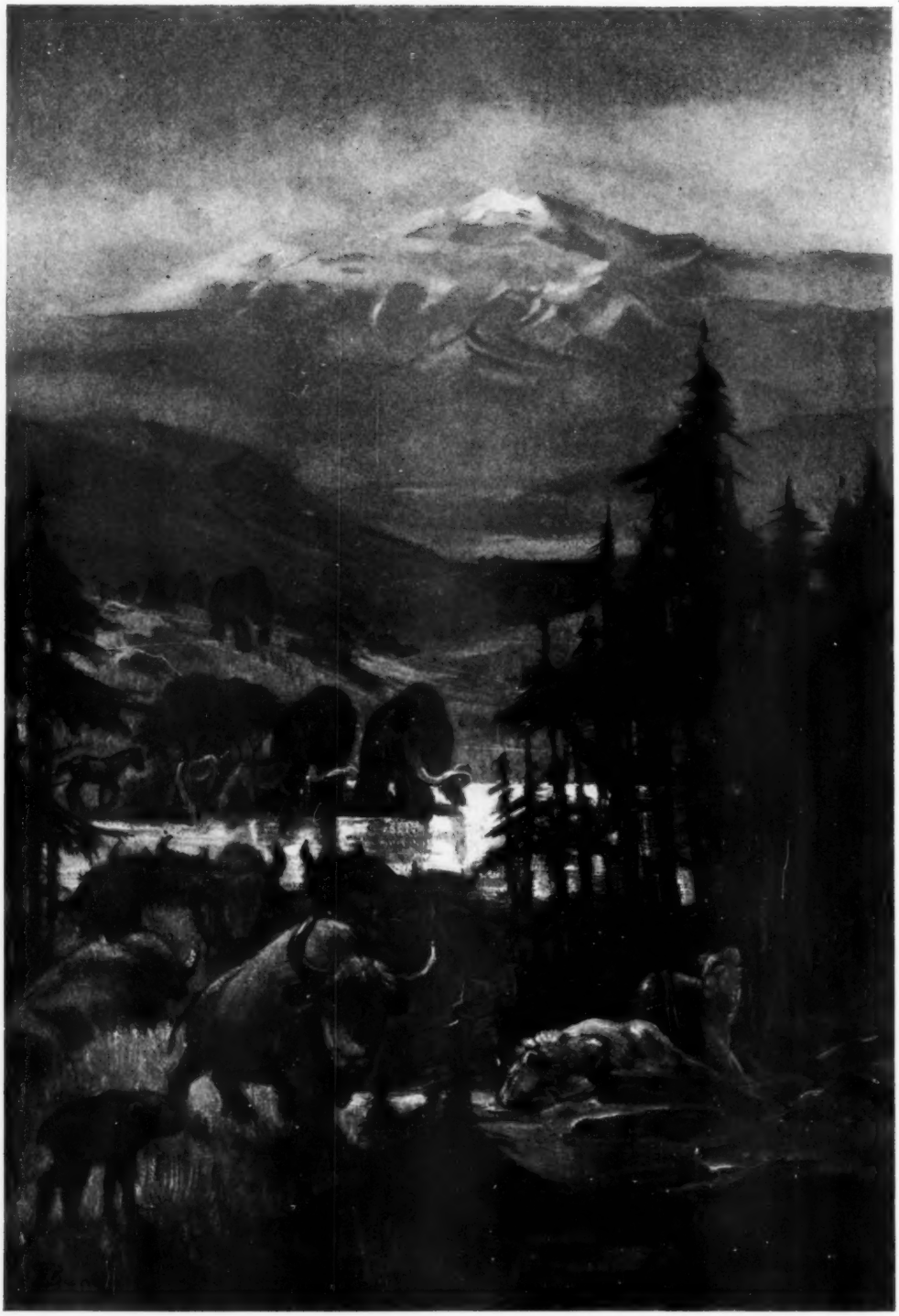


From a Painting by Mrs. E. Rungius Fulda

ALASKA IN PLEISTOCENE TIMES

Lions watering with herds of bison, mammoth, and horses, on the shores of an ancient Alaskan lake to the north of Mt. McKinley

See "Alaska's Frozen Fauna," page 71

VOLUME XXX

NATURAL HISTORY

NUMBER ONE

JANUARY-FEBRUARY, 1930

THE SEARCH FOR THE GIANT PANDA

The Story of the First Expedition Ever to Collect the Strange Raccoon Bear Near the Border of Tibet—How the Field Museum Expedition Obtained the First Specimen of the Rare Beishung, an Animal Never Before Seen by White Men

By KERMIT ROOSEVELT

With Photographs by Suydam Cutting and Kermit Roosevelt

ONE of the least accessible corners of the world is that rugged mountainous country forming the borderland between China and Tibet. In these days of ubiquitous motor cars, it almost alone remains inaccessible to any form of motor traffic. Probably many years will elapse before it is opened up.

It is a wild and lonely region. Such inhabitants as there are, belong to very different races and speak widely differing languages. It is a fertile field for the ethnologist, but much must always remain a closed book, for there is little to be found in the way of written documents or inscriptions.

The Field Museum Expedition which my brother and I were leading, at first hoped to get permission from Lhassa to go through Assam and cross over Tibet into China. However, once more it proved impossible to "hurry the East," and it was not until after we were well embarked on the alternate route, through Burma, that the permission of the Tibetan authorities finally reached us. Unfortunately the season was too far advanced to allow of our returning.

Going up the Irriwaddy River from Rangoon, we bought mules at Bhamo and crossed over into Yunnan province in China. From Talifu we struck due north to Likiang and Yungning. We then entered the semi-independent kingdom of Muli. We could get no maps of this district which were even approximately correct.

It was midwinter and bitterly cold, with the snow lying deep on the mountains. The greater part of the time we were traveling at an altitude of between ten and fourteen thousand feet, and some of the passes over which we crossed exceeded seventeen thousand feet. The wind that swept down from the lofty snow peaks cut through our clothes like a knife, and each night we bundled on everything we could find before crawling into our arctic sleeping bags. Even so, it would be some time before we became sufficiently warm to be able to sleep.

The provinces of Yunnan and Szechuan are so remote from the Central Government that they are, to a great extent, a law unto themselves. During these last troublous years, brigandage has been

THE WALL OF TENGYUEH

The famous walls of China which in ancient times were built around its cities are now being torn down. The picturesque example shown above will probably not stand much longer

rife. Many of the bandits were formerly soldiers and took up their present trade as a result of receiving no pay and very scanty sustenance. Some of these outlaw leaders are notorious characters. We found the population of Likiang greatly disturbed at the report that Chang Chi Pa was planning an assault upon the town. His name means Chang, the stutterer. He is an ex-muleteer and bears a peculiarly sinister reputation. The country people repeated many stories of his cruelty, and it was evident that they placed implicit belief in the tales that they told us. One story was to the effect that every day he ate a human heart, both to impress his followers and to terrify his victims. He is no respecter of persons, layman and lama alike have suffered at his hands. He had hung up one of the lamas at Yunging by his thumbs to a tree, weighting his feet with rocks. Although the wretched man was rescued, he never recovered from the effects of the torture. The territory offers many advantages to the enterprising bandit, for it is almost impossible to capture him in his mountain fastnesses except through the treachery of some follower. Such is the poverty of the country, however, that it can offer but lean pickings to even the most active bandit. They can hope for but little from the inhabitants and must draw most of their revenue from the trading caravans that pass through.

Great bands of Tibetan marauders terrify this unfortunate country, and periodically, during the caravan season, take their toll of man and merchandise. We passed through several regions where the government was carrying on military operations against the bandits, but they never seemed to be very effectual. In the towns there were sometimes notices forbidding any inhabitant to have dealings with a bandit under penalty of

death. Some of the notices naively instructed an inhabitant meeting a bandit, to kill him, but failed to specify just how this was to be managed.

We were fortunate, ourselves, in avoiding any disagreeable encounters. As a matter of fact, our caravan possessed little that would have been of value to bandits with the exception of our arms and ammunition, and presumably we would not surrender the former until we had finished the latter. At least twice we were in very close proximity to groups of bandits. On one occasion we had, for several days, been trekking down stream along the banks of a small river. It entered into a series of gorges, obliging us to turn off from the bank and cross over a snowy and well forested mountain. The night before reaching the cañon we spent in a small village where we were regaled with numerous accounts of banditry.

Early the next morning, a small party of natives set off on the trail ahead of us. It was not long before three or four of them came hurrying back to say that they had been attacked by bandits. In the little town we were told that on the previous evening word had been sent across the pass to the village situated where the trail rejoined the river, asking that some soldiers be dispatched to meet us at the top of the pass. We were strongly urged, however, to wait a few days to see if the bandits would not leave the district.

In addition to my brother and Suydam Cutting, there were with us two Kashmir shikarries. The latter we armed with our spare rifles, and since the reports did not indicate a large band of outlaws, we felt it very unlikely that they would attack. Our crossing was uneventful except for the occasional excitement of some native's insisting that he could see a bandit. We

FIVE MEMBERS OF THE EXPEDITION
From left to right: Jack Young, Herbert Stevens, Theodore Roosevelt, Philip Tao, and Suydam Cutting

A HALT AT A LAMASERY

While making an overnight stop at this Yungning lamasery, the party met Dr. Joseph Rock, the famous botanist and explorer

TIBETAN WOMEN

The origin of the Tibetans is hidden in obscurity, but their characteristic customs indicate that they are members of a very ancient culture

LOLO WOMEN

The Lolos were found to be pleasant companions and helpful hosts. Physically they reminded the members of the expedition of the American Indian

A MEAT DEALER AT LIKIANG

Such merchants are allotted certain days each week to display their wares. This system of market rotation prevents great competition

THE UPPER YANGTSE

This great river, cutting its way through the precipitous rocks, discharges about six billion cubic feet of silt at its mouth annually

HEAD LAMAS

Tibet is the principal seat of that form of Buddhism known as Lamaism. These Lamas are from the semi-independent kingdom of Muli

had entirely forgotten the guard that was supposed to meet us at the pass until we reached the village at the farther side, where we were greeted with anxious inquiries from the villagers as to their militia. It later developed that five armed men had been dispatched to meet us and that they had fallen in with the bandits, twenty in number, who had carried them off, rifles and all.

The other occasion when we came close to an encounter, was one rainy morning in April while crossing a high pass after we had turned south and were headed toward Indo-China. Four and a half hours brought us to the summit. The rain had degenerated into a heavy Scotch mist, at times so dense that it was impossible to see farther than a few yards. Snow lay on the trail, and the tea coolies bound for Ta Tsien Lu, were making heavy weather. They thronged the rude wayside hostelries which we passed from time to time.

Descending the farther side, we passed

two palanquins halted before an inn. One only was occupied and its occupant was obviously much wrought up, but we were unable to understand his troubles until we later met him at the Magistrate's at Tsingki Hsien, and learned that his companion had been plucked by bandits from the other palanquin. They had carried him and all his belongings off into their mountain haunts. All this had occurred only a few hours before we passed, so we considered ourselves fortunate. We had received no warning of bandit activities and were straggling along in the rain and mist in no very good form to protect our goods. The eager questions with which we were hailed while coming down the trail into town, and which had been completely unintelligible to us, were now explained. We never learned with what success the disconsolate Chinaman met in retrieving his friend.

The parts of Yunnan and Szechuan through which we passed can by no

SHAN WOMEN GOING TO MARKET
These people are members of a group of Mongoloid tribes of the Tai stock found throughout Indo-China, but especially in the Shan states

CROSSING THE YALUNG RIVER
The Yalung is one of the main tributaries of the Upper Yangtse, and has its origin in the little known highlands of northeastern Tibet

BRICK TEA BOUND FOR TIBET
The heavily loaded and ubiquitous Chinese porter is to be found on the rough trails throughout China. These porters sometimes carry as much as 400 pounds at a time, and the road to Tibet is nearly all uphill

stretch of the imagination be termed a big game paradise. It is no country for the inexperienced hunter nor for one who wishes to secure a large bag without undue expenditure of time and effort. An experienced hunter, who is not obliged to hurry, can, however, secure a varied bag, and be certain that practically every animal he collects will prove of great interest, with a very definite possibility of finding it a new species or subspecies.

The first prize is the giant panda, whose scientific name is *Aeluropus Melanoleucus*. The natives know him as the beishung or white bear. To the best of our judgment, he has a fairly wide area of distribution, but is to be found only in pockets, and is never abundant, even in these pockets. He lives in the bamboo jungles in altitudes varying between six and fourteen thousand feet. We came to the conclusion that it could be safely assumed that where there were no bamboo jungles, there were no beishung. Native information required careful checking, for even after a detailed description of the animal, accompanied by showing a plate depicting it, we could not rely on a native's word as to its presence in a district. Sometimes this was due to very hazy notions of coloration and the assumption that the white crescent on the black bear's chest entitled it to be called a beishung. At other times misinformation was wilful, either with the common impulse to give pleasant and agreeable news or because the native counted on earning some money as guide before his deception could be discovered. We took no one's word as guarantee of the presence of beishung. Where he actually exists, his droppings are frequent, and easy to find, and even easier to identify. His diet appears to

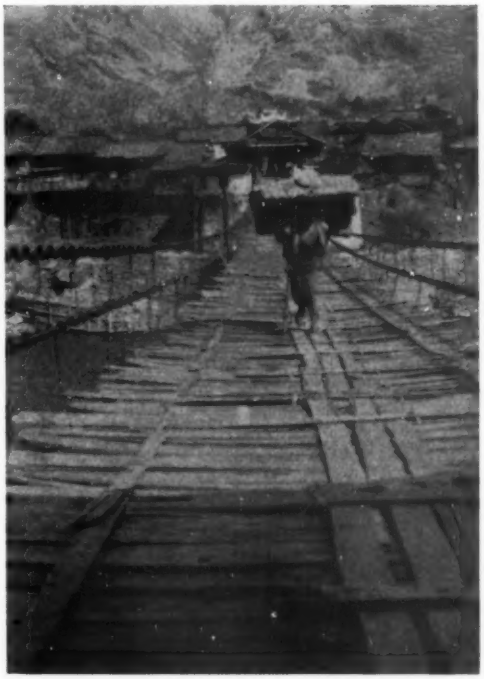
TWO FRENCH PRIESTS
Père Gaborian and Père Valerian. The former has spent 52 years in China

consist exclusively of the shoots and stalks of the bamboo. The Muping and Yehli districts were the only places where, after diligent and unceasing inquiry throughout the trip, we could be convinced of the presence of giant panda. Owing to their scarcity and the nature of the country in which they live, the prospects of getting a shot at one are very slender. With a pack of good bear hounds they should not be so difficult to secure.

The first time that we came upon indubitable traces of the giant panda's presence was in the Muping country, a hundred miles or so northeast of Ta Tsien Lu in the province of Szechuan. It was in March, and the snow lay deep on the mountains. We gathered half a dozen local hunters. Each man had a dog, small wiry animals, either black or brown.

For the next ten days we hunted that country thoroughly. We came across numerous signs, and once we found tracks two or three days old. The bamboo jungles were dense, and ten yards was about the limit of one's vision. The dogs were a distinct disappointment; their sense of smell was quite evidently only fair, and we felt that their only value lay in perhaps starting an animal, and driving him up a tree. We knew that we could not count on them for any sustained effort. Each morning at dawn we set out hopefully and each evening at dark we trooped in considerably less hopefully. At length we had to admit the slimness of our chances, and put our trust in coming upon a giant panda country farther on that would afford a better opportunity.

It was in the Lolo country that we next came upon authentic news of the animal.



A SUSPENSION BRIDGE IN SZECHUAN
The chains show that this bridge is an important one. Some of the "bridges" of this region consist merely of one or two suspended bamboo cables by means of which the traveler makes a precarious crossing

CHURNING TIBETAN BUTTERED TEA
This widely used preparation is made of very strong tea and rancid butter

We had been warned by the Chinese authorities living on the border of Lololand that we would run into trouble with the inhabitants. The missionaries also tried to dissuade us from going, but we thought that if we took things quietly at first, we could probably win over the local chieftains and secure their support. In this we were not disappointed, for after passing through the initial stage of thinly veiled distrust and hostility, we found the Lolos pleasant companions and helpful hosts.

They are a sturdy, upstanding lot, and physically reminded us strongly of the American Red Indian. They knew of the giant panda, but they said they were excessively rare. For this there did not seem to be any explanation since the Lolo regards the beast as a semi-divinity, and does not attack it except in protection of his beehives. These the giant panda sometimes raids. It was near Yehli, perhaps two hundred miles northwest of Ningyuan, that at last our efforts were crowned with success.

THE MAGISTRATE AT CHINLUNG
This official was very friendly to the expedition

The beishung does not hibernate. We found fresh signs in regions where the brown and black bears were hibernating, and the one we shot was living in a locality where the black bears had not yet awaked from their winter's nap. We came upon his tracks one morning in the newly fallen snow. They were partly obliterated, for four or five hours had passed since he went by. Three hours' trailing through dense jungle brought us to the spot which he had selected for his siesta. We caught sight of him emerging from the hollow bole of a giant fir tree, and fired simultaneously.

The giant panda, from all we could learn, is not a savage animal. After the shooting, our Kashmir shikarries remarked that he was a sahib, a gentleman, for when hit he had remained silent, and had not called out as does a bear. In the nearest Chinese village, perhaps twenty-five miles distant, no one had ever heard of a giant panda, nor seen the skin of one. Other incidents of this nature continually confirmed our belief in the animal's scarcity.

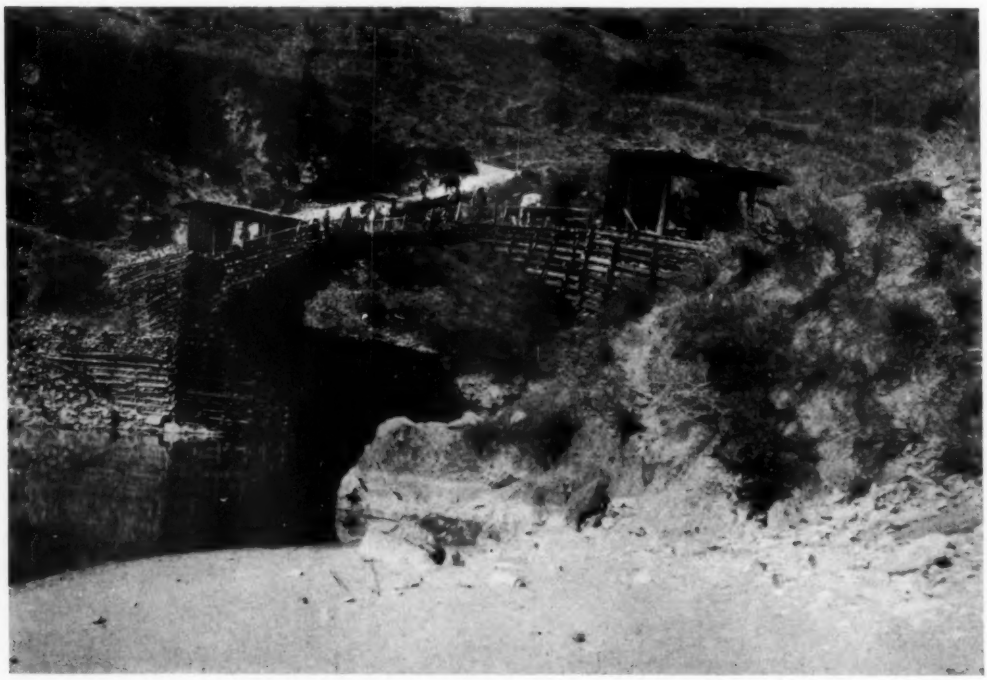
In addition to the giant panda, we were fortunate enough to secure a fine group of the rare golden monkeys. These animals live at an elevation varying between eight and fourteen thousand feet and are regarded as a great prize by the natives. The coloring of the old males is a most striking, vivid orange. On their backs they have a mane four or five inches long of a less brilliant hue. One would think that they would be easy to distinguish, but the jungles which they inhabit are so dense and the trees so tall that it is by no means simple to find them.

RICE FIELDS OF NINGYUAN
In these elaborately irrigated fields, the Chinese of the district raise their principal crop. Every rice plant is set out by hand

AT THE CHINA INLAND MISSION, TA TSIEN LU
Kermit Roosevelt, the author of this article, stands fourth from the right in this group which shows the members of the expedition

THE SNOWY WASTES OF MULI

The greater part of the time the expedition was traveling at an altitude of between ten thousand and fourteen thousand feet



A BRIDGE ACROSS THE UPPER MEKONG

Despite the heavy construction of this bridge it is used for foot travelers only. It has been sturdily built, however, to prevent its being washed away by the frequent floods

MOUNT KOOHKA, IN SOUTHERN CHINA

A mysterious peak which is situated in the midst of an almost inaccessible region that few white men have penetrated. Its height is unknown

A LOLO HOME

This house, in the Yehli country, was used as a base camp of the expedition and it was near here that the giant panda was finally secured

We also collected the bhurel, or blue sheep, the sambhur, and the serow. We could have secured other game had we not been forced to bend our energies almost exclusively to getting the giant panda. For this reason, we were often obliged to neglect opportunities whereby we might have collected other animals of interest.

The expedition, however, was composed of many parts, and aside from the large game, much valuable material was collected. Four naturalists under the direction of Harold Coolidge, were sent direct to Indo-China, while my brother, Suydam Cutting, and myself had with us Herbert Stevens, the noted ornithologist from Tring. Mr. Stevens left the main body of the expedition at Likiang in order to proceed more at his leisure and to secure a more representative collection. There will be much of interest to be found in this collection when there has been an opportunity for working it out.

A night's halt in the Muli country

Capt. Kingdom Ward, the well known botanist, also formed part of the expedition, carrying on his work in the districts of southern Yunnan and that part of Indo-China in the neighborhood of Luang Prabang.

Early in May, Cutting, my brother, and myself reached Yunnanfu, which is the railhead for the French railway from Hanoi in Indo-China. Although we had only a relatively small collection of big game to show for our work, we were more than satisfied with the great good fortune that enabled us to bring out the first complete specimen of the giant panda. We have been unable to find any record of this beishung ever before having been collected by a white man, although since 1869 when a French missionary, Père David, first traded a skin from the natives near Muping there have been many efforts to shoot the animal. We felt that the success which crowned our work was due very largely to a fortunate combination of circumstances, and had we been told to return and bring out another panda, we would not have felt like offering any guarantee whatever as to our ultimate success.

IN QUEST OF THE QUEEN OF SHEBA'S ANTELOPE

IN TWO PARTS—PART I

An Account of an Expedition in Search of Abyssinian Nyala—The Strange Mosaic of Potentates and Bandits, Deserts and Jungles, Mountain Peaks and Sandy Plains, and Insect-infested Swamps that Formed the Background of the Sanford-LeGendre Expedition

By GERTRUDE SANFORD AND SIDNEY LEGENDRE

Photographs by Gertrude Sanford and T. Donald Carter

DJIBUTI, hot, dusty, its low, white buildings crouching under the sun, its streets filled with half-naked natives, was our landing place and first stepping-stone to Addis Ababa, the capital of Abyssinia. Thence we were to organize our caravan before plunging into the interior in search of the nyala. Away off in the distance, the barren, rocky mountains of French Somaliland stretched until they met the horizon and were no more. As themselves, they were uninteresting, but, representing the gateway to Abyssinia, they took on a poignant significance and a charm for which they were in no way responsible.

The expedition, which had as its object the collection of material for a nyala group for the American Museum, included Miss Gertrude Sanford, Morris LeGendre, Sidney LeGendre, and T. Donald Carter.

Mr. and Mrs. Southard, the American Minister at Abyssinia, were in Djibuti at the time. They did all in their power to aid us, and materially hastened what would otherwise have been a slow and heartbreaking task. Our equipment gradually found its way to the train, and we ourselves sank back (if such a thing is possible on the seats provided) and prepared for the three-day trip to Addis.

Until one reaches Dira Dawa, the country is desolate; great mountains of red rock rear their heads above the railroad, which twists and turns until one is afraid that the engine and rear car will collide. There is no sign of animal life, and only at the stations are humans to be seen. They issue from their wretched huts, bearing in their hands flat cakes of bread, "injera," or a jug of native beer, "tala." These they peddle up and down the train. You may buy the jug outright, or a drink; the latter method provokes arguments which fairly shake the miserable little train off its narrow rails: How much did you drink, and, should the next customer rush to buy the jug outright, what damage has been done by your drinking, and how much should he deduct from the original price? This argument is often ended by the departure of the train. The customer continues to hold the jug between both hands, the merchant runs beside the train demanding payment and declaiming to the world in the same breath that on the train there is a bandit whose ancestors had all been bandits, and whose children would undoubtedly be so. However, only the very young are caught in this manner; the old ones never let go their wares, but cling tightly, knowing the ways of men and especially of those who travel in railway coaches.

As we journeyed on from Dira Dawa, the vista changed. The great mountains were still there, but between them lay valleys covered with a coarse grass. Here and there a thorn tree raised its ugly head and then seemed to droop

NATIVE QUARTERS IN DJIBUTI
The homes of the Somalis are small, rounded hovels, roofed over with thatch, skins, and bagging, with no thought of sanitation

dejectedly at the sight of what lay about it. In these great arid spaces there was wild life: tora hartebeest, Soemmerring's gazelle, kudu, and dik-dik. There are also lions and leopards, but of these we saw nothing.

The first view one has of Addis is beautiful. Situated on the side of a mountain, surrounded by eucalyptus trees, it looks a haven of refuge after the heat and dust of the journey. It is only upon one's arrival that this illusion is dispersed. The station is the general meeting place for all persons who have nothing to do; consequently it is overflowing with humanity. Everyone carries a gun upon his shoulder, or is followed by a servant who acts as gun-bearer, thus attaining a certain amount of dignity in the eyes of his class. Coolies seize your baggage and treat it as their own. Once it has passed from your hands, there is nothing to do but to follow with the hope of eventually regaining at least part of what was once all yours. Here again Mr. Southard helped us a great deal by facilitating the passage of our baggage through the Customs. Without his aid, it would have been a long and tedious task, attended with much signing of papers, which no one is able to read.

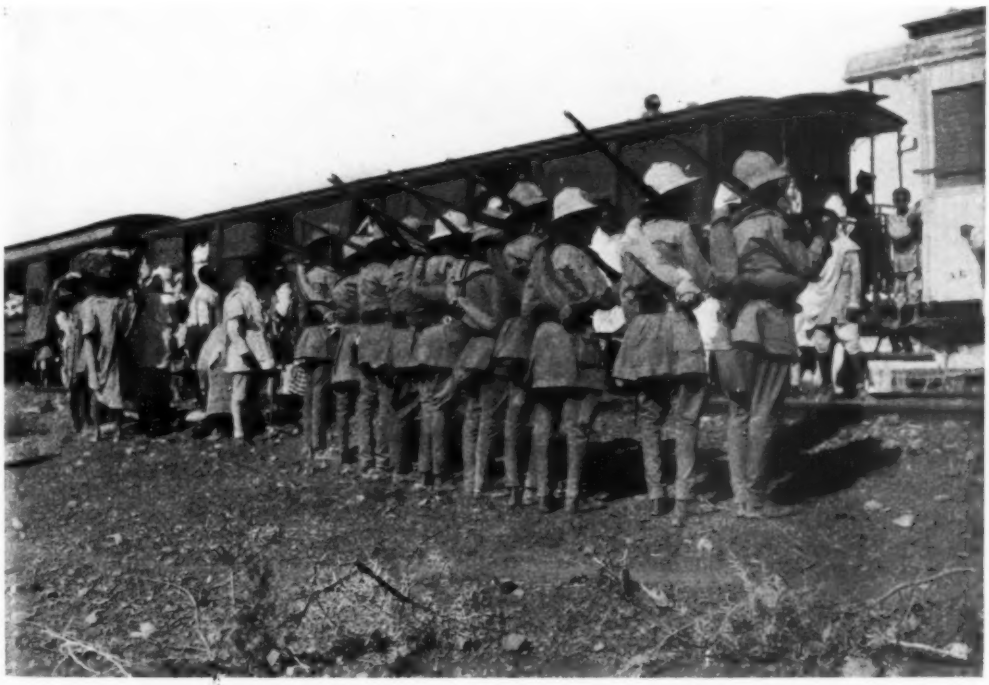
The succeeding days were spent preparing for our trip. In Abyssinia, no one knows the meaning of hurry. Tomorrow is as good as today and, when there is work to be done, a great deal better.

In the midst of all of this, we received an invitation from the King, requesting us to dine with him the following evening. We dined in his private palace, and with a host and hostess as charming and delightful as His Majesty Negus Tafari Makonen, and Her Highness, the Queen, one could not but sigh when the time came to leave.

The palace is in perfect taste. Passing between the double line of guards, one enters a small anteroom, and from there, through colossal doors, into the Throne Room, where we were received.

Standing on a magnificent tiger skin, their Majesties awaited us. The King speaks French perfectly, and while he and Miss Sanford talked, the others conversed with the Queen and Ministers of State who were present. The dinner was a masterpiece of culinary art, prepared by his French chef Chambard. A native beverage, "tedge" was served, an amber-colored liquid, slightly sweet, made from honey that has been fermented and distilled. It is the favorite drink of the nobility. That of the common people is "tala." In color this is a dirty gray, resembling dishwater in its consistency and sour in taste. Bits of barley, from which it is made, float on the top, and it is a matter of time before an appreciation of its value is born in the palate of the stranger.

The morning after the dinner a man arrived at the hotel. Behind him followed a little boy, leading a splendid mule covered with embroidered velvet. Around his neck was a magnificent necklace of silver, and on his back two red pommels rose above a saddle made of various layers of embroidered velvet. The man, who acted quite important enough to be an ambassador, was extraordinarily secretive. He would see no one but Miss Sanford. When she finally appeared, he made a long speech in Amharick and placed the leading rein of the mule in her hand. Through various interpreters, (who always appear out of nowhere on such occasions), we discovered that this was a present to Miss Sanford from the King. The animal's paces were perfect and later it turned out to be the best mule that we had.



ABYSSINIAN SOLDIERS GUARDING THE RAILROADS
At each station the railroad is guarded by a stone block house, and, as trains pull in, the guard lines up at attention

The preparations for our caravan were drawing to a close. Morris LeGendre wished to get the men away as soon as possible, for, though the Abyssinians are faithful servants on trek, yet the attractions of a city do away with all ideas of work. He and Mr. Carter, therefore, set a day for departure. As usual, everything happened that could happen; the mules bucked off their loads; the men leading them let go of the ropes, and all the mules ran away, distributing the baggage over the country-side as they went. Finally, at 1:30, the caravan moved off as a body, with Morris LeGendre and Mr. Carter in the lead.

Miss Sanford and Sidney LeGendre rode back to the city to complete various matters that were still in that unfinished state so dear to the Abyssinian heart. It was necessary to procure piastres, the small coins which are current in the country. The value of these coins is beyond all human knowledge. Certainly one must be born in the country to understand the signs which condemn or lift a coin to the realm of acceptability. In Addis there are sixteen piastres to the dollar and any piastre is acceptable, but as one goes into the interior, only certain coins are taken. They must be brand new and very shiny. On the back of each piastre is the figure of a lion whose tail curls over his back in disdainful fashion. Should the tip of the tail point upward, then it is a good coin, but should the entire length of this creature's tail continue parallel to the ground, then no right-thinking person will touch it. It is also curious that only the Marie Theresa silver dollar of the year 1879 is acceptable; any other dollar is worthless; hence the Government is forced to stamp all of its dollars 1879, no matter what the date of their coinage.

The difficulty that presents itself in

ABYSSINIAN NATIVES AT THE STATION
The arrival of a train always excites the keenest interest, and the entire population of the town flocks to the station

MARKET SCENE AT ADDIS ABABA

Throughout the city there are numerous open-air markets where most of the trading is carried on. Among the wares that are bartered for, are mules, cattle, hay, firewood, grain, salt, rice, and peppers

obtaining these piastres is extraordinary. Miss Sanford and Mr. Le Gendre went to the Treasury, where they were told they could not have any unless they brought an order from the Lord High Treasurer. They went to his house and were told that his uncle had just died and that he was at the funeral, where he would mourn for seven days and seven nights. During that period he would not return to his office or house. It was impossible to delay departure for seven days, so they went to the wake in search of the Minister of Finance.

They came to a great round tent in the center of a grove of eucalyptus trees. From the interior issued the throbbing of drums and the hum of voices. Miss Sanford and Mr. LeGendre sent a boy in with the message that they would like to see His Excellency on matters of finance. Before they had time to catch their breath, they were led into the tent and found themselves in the center of a circle of men who were seated upon the ground bewailing the deceased. Certainly there are many more desirable places in which to carry on business than in the middle of a funeral party, but longer delay was out of the question. Miss Sanford carried on the business, for the Minister spoke only French. After a great deal of talking, the old man drew forth a notebook, and, writing upon a page, tore it out and gave it to Miss Sanford. This was the order on the Treasury to give piastres in exchange for dollars. Rushing to the guardian of the State's wealth, they presented the slip and demanded sacks of silver. Then arose an incident which cannot be duplicated in any country but Abyssinia. The Treasury refused to take the paper money which they themselves had printed and issued. In exchange for the silver piastres, they would accept only the silver Marie Therese dollars issued in

A NATIVE GENTLEMAN WITH HIS RETINUE
A man's standing in Abyssinian society is gauged by the numerical strength of his bodyguard, which must accompany him wherever he may go

Italy. The money safely stowed away in saddle bags, Miss Sanford and Mr. LeGendre set out to overtake the caravan which was now several days ahead.

Rejoining it at Mojo, all worked on reapportioning the loads to each mule. Morris LeGendre devised a very clever method of preventing the boxes from slipping from the pack saddle by extending a strip of wood from each end of the case so that it reached to the fork of the saddle, thus holding the box from going either forward or backward. The loads were held in position through the use of a sling hitch, which was far superior to the Abyssinian method of securing a load by simply winding a machana around and around the load and mule until all was supposed to be secure, which never proved to be so.

We had brought the regulation burro saddles, made by Flynn. These fitted the mules perfectly and were a great aid in avoiding the sore backs so common among the pack animals of this country. The wretched condition of the mules, driven by the *nagadis*, the professional caravaneers, is unbelievable. The skin along the back bone is completely rubbed away, leaving the raw, bleeding flesh, in which great ulcers, rimmed with flies, exude pus that flows down the sides of the animals in ugly patches. However, such a back is no hindrance to these men, for they will pile on their loads irrespective of the pitiful sight.

The trails, dusty and hot, crept out of the dawn and were immediately covered with caravans winding like giant, distorted serpents, for always the tail end was the most populous. For some unknown reason, natives will always congregate behind the last animal and, singing and shouting, will pursue their way, irrespective of slipping loads and straying mules in the front.

Shortly before arriving at the Hawash River, we passed a magnificent pageant: natives mounted on superb Arab steeds pursued one another. The pursuer carried a spear in his hand and, standing in his stirrups, would cast it at his enemy, who was galloping away in full flight. The latter attempted to ward off the lance with a small shield which he carried strapped to his left arm. One perfect specimen of manhood, leopard skin thrown over his shoulder and a lion mane over his head, was the winner of all prizes. He seemed to be part of his horse, and each throw was a hit. Apparently he was some great personage, for the crowds roared with approval each time his turn came to attack.

That night our camp was pitched on a bluff, overlooking the Hawash River. Dirty and shallow it was, at this place, yet it is the principal river of Abyssinia. Originating in the north, it disappears in the great swamps of the Danakil country. Very little is known of its final end, for the Danakil are a ferocious tribe, exceedingly warlike, with the reputation of killing any stranger found within their boundaries.

Somehow our caravan had not managed to arrive in its entirety. The cook, an important item to our minds, and three mule boys, were unaccounted for. We did not leave the following morning, hoping that they would come in during the course of the day. Meanwhile Mr. Carter and Morris LeGendre secured several specimens of the exceedingly common Egyptian goose and yellow-billed duck, as well as guinea fowl, but game was not plentiful, for one of the main caravan routes crossed here and natives were constantly driving their cattle to the river or bringing skins and coffee to Addis.

CAMEL TRAINS IN ADDIS ABABA

Coffee and hides are the chief exports of Abyssinia, and these are brought into Addis Ababa from the outlying districts by pack mules or camel caravan

THE "TREE OF LIFE"

The *shiftas* (bandits) who have been captured by the government are hung from the boughs of this tree, which is situated in the center of the town. This is dire warning to the citizens

Late that evening our head mule boy arrived with the news that our cook and other boys had lost their way and were at Toka market. It was a day's journey away, but nevertheless on one of the routes to Lake Zwai.

The following morning as the sun crept over the horizon, turning the river into a stream of gold and lavender, across which great black shadows threw their points from shore to shore, we crossed with our caravan.

As the sun rose the heat increased. It came as a drawn sword off the plains, drove through our helmets, and seemed to pierce our brains. The red rocks glared and faded in the heat waves.

A mountain range lay before us. We crossed it and on the farther side found a great plain hemmed in by tall mountains. It looked like the bottom of a bowl. In the center were two gigantic fig trees. They were Toka market. Once a week the natives of the surrounding country met to trade. Here we found our lost boys, and camped for the night.

In the morning the chief of the district asked if he might accompany us to Lake Zwai, for he did not wish to travel alone for fear of *shiftas* (bandits), who are the curse of the country. He arrived with fifty men. All were armed and the greater number were mounted.

Bora Spring was our destination, for there, we were told, was water, and a curious type of klipspringer found only on the surrounding mountains. When we arrived, there was scarcely any water to be found. A thin trickle crept from a cleft in the rocks at the bottom of a deep gorge. It required hours of irritating waiting and arduous labor before all of our fifty-eight mules were watered.

At sunrise Miss Sanford, Mr. Carter, and Sydney LeGendre climbed Bora Mountain, hoping to secure the extra-

ordinary klipspringer that the natives had spoken of, and possibly also a kudu, which, it was said, roamed these hills in great numbers.

Morris LeGendre took the caravan on to Lake Zwai, where the others joined him that evening, having been unable to secure any specimens.

Lake Zwai lies sixty miles south of Addis. From a distance its waters look like the bluest in the world, sparkling and turning to silver under the sun, but on closer inspection they are a dirty, reddish color, so filthy indeed that it is impossible even to bathe in these waters unless they have been previously strained through a cloth.

Bird life was abundant. Spur-winged and Egyptian geese, teal, shovelers and yellow-billed ducks, as well as numerous cranes, storks, herons, ibises, and a large flock of white pelicans were seen either on or near its shores. A curious red fish found in the lake proved to be very palatable. The shores are swampy, there being no rock or gravel beaches. In the distance low hills seem to rise from the lake in all their barren hideousness. Here kudu were to be found, according to a native who assured us that he was the greatest hunter in that part of the country, if not in Abyssinia. Not sufficiently hardened to the stories of these master tale spinners, we yielded and followed him to the hills. All day we climbed and that evening slept on a bleak plateau, waterless and gameless. Where there was to have been game, there were only caves, and where there was to have been water, we found the dried bed of a stream.

It was useless to continue to listen to the advice of these men. They knew nothing about their own country, due to their fear that they would be robbed and

PACKING UNDER DIFFICULTIES
Mules were always obstreperous until broken to their packs, and, although held by five men, they often succeeded in bucking off the loads

killed or enslaved, if they ever entered the territory of another tribe. They possess a very vague knowledge of the types of animals by which they are surrounded and know nothing at all about their habits. In hunting, when they see a wild creature, they immediately raise themselves to their full height and point. Such tactics are not conducive to securing the nyala, a very cautious and easily frightened animal. If we were to succeed, it was plain that it would be necessary to rely solely on our own judgment.

Taking one pack mule, on which we placed our blankets and food, the four of us started on a tour of exploration toward Mount Chilalo, whose green slopes could be seen from our camp. We explored the mountains, we explored the country around it, we questioned the natives, but nowhere could we find a trace of the nyalas. They seemed to be unknown, a thing of the imagination only.

Our food gave out and we were reduced to living on the game we could shoot. At sunset we saw two fat geese waddling on the side of a hill that sloped into a stream. Carter crept over the ground while we stood and watched. Would he never be close enough? He was raising his gun. It was incredible! He could never get them at that distance. What was he thinking of? There was a report. We expected to see the pair happily winging their way toward a safer dinner, but no, there they were, flapping about upon the ground. Our boys rushed toward them, shouting and brandishing their knives, for it is essential that they cut the throat of any animal they wish to eat. No amount of yelling would stop them, and Mr. Carter arrived just in time to prevent their cutting the necks of both. One had been slightly damaged, but not irrepar-

THE KING'S GIFT

Miss Sanford with the mule and trappings presented to her by His Majesty, Negus Tafari Makonen. The saddle blanket was of green velvet embroidered with red and gold. The halter was also gaily decorated

HIS MAJESTY, NEGUS TAFARI MAKONEN

Riding on a mule, and under a silken umbrella embroidered with gold, the king of Abyssinia leaves the parade ground after witnessing native celebrations which followed the annual ceremony of the blessing of the river

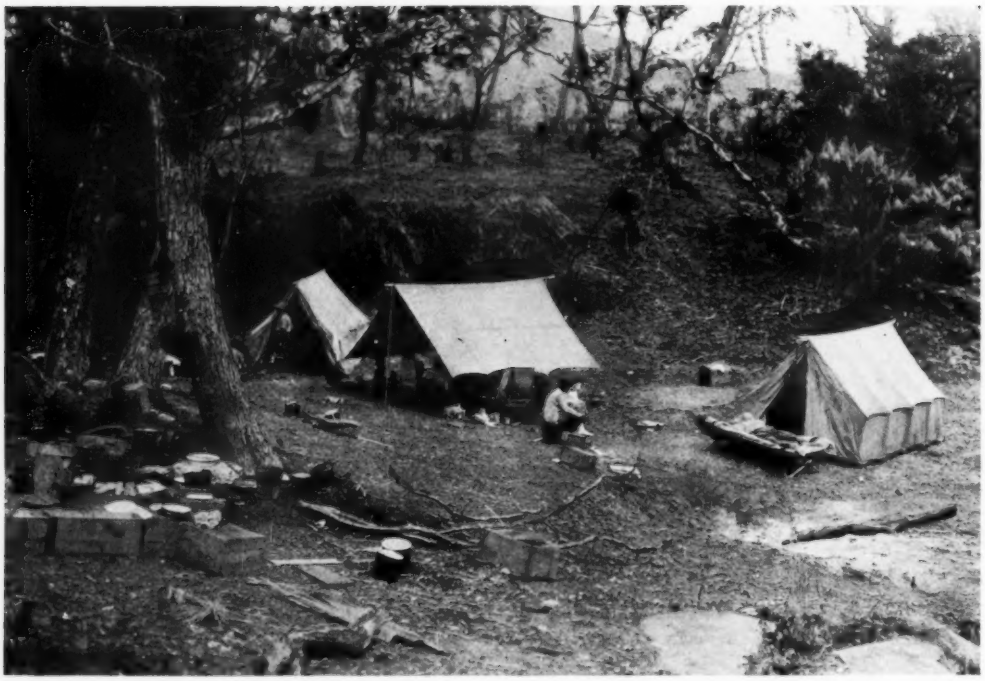
ably. They were our first important specimens—two blue-winged geese, a bird found only on the high plateaus in Abyssinia.

Returning to our camp two days later, we bewailed the fact that we could not find a map which had been drawn for us on the back of a book by an old Belgian coffee planter. Here he had shown exactly what mountain ranges to go to, and, in fact, even on what mountain we might find the nyala. Had we left it in the train, or was it in one of our rooms at the old ramshackle hotel in Addis? Would it be worth while for one of us to take two horses and by changing back and forth try to make a rush trip to Addis? Wouldn't it be useless, for we were not sure even that the book was there? In the midst of our discussion, Hassan, our old interpreter, came to the front of the fly under which we were sitting.

"I beg your pardon," he said, "but I heard you talking of a book. I borrowed one from your supplies before we left, in order to improve my English."

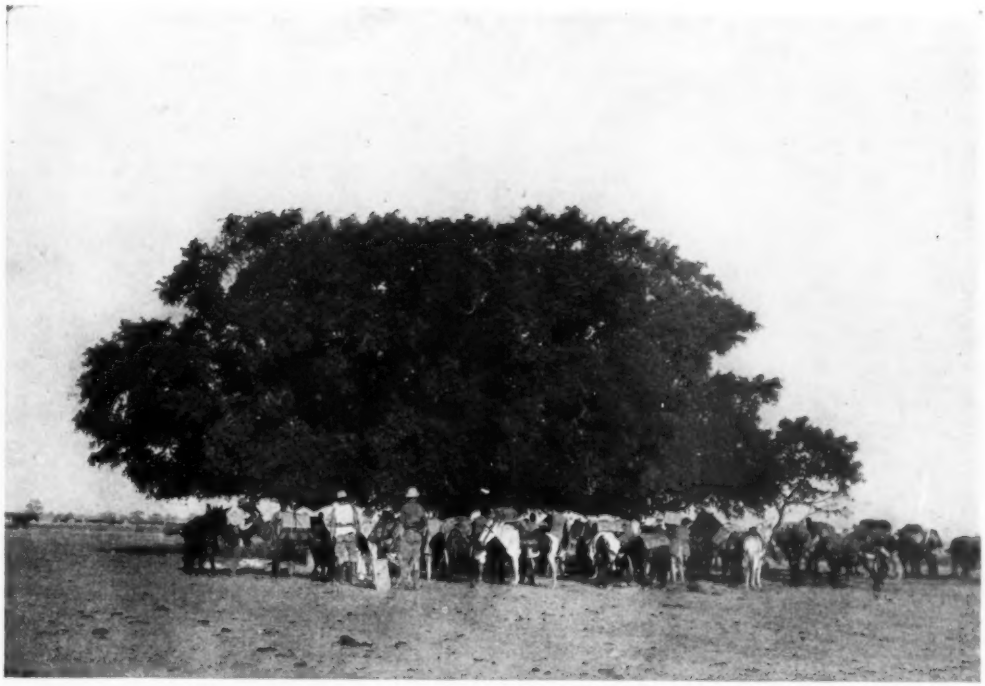
We looked at one another. It was absurd, impossible. How out of a hundred books could he have brought the one—the one with the map? A false hope, it was foolish even to think it could be true. He was coming back with a book in his hand. Handing it to Morris LeGendre, he stood waiting. No one said a word. Morris held it for a moment and then threw back the cover. There was a moment's silence and then he let out a great "Whoop!" There was the map!

In a moment we had found our position. It was noon, but orders were immediately given for the breaking up of the camp. Tents were struck, mules were packed, and well within two hours we were on our way.



CAMP AT THE FOOT OF CHICKA MOUNTAIN
It was here that base camp was established and the main part of the caravan remained, while the surrounding hills were scoured for zoological specimens which were brought in periodically for preparation

MORRIS AND SIDNEY LEGENDRE AT CHICKA CAMP
The expedition's camp in the Chicka Mountains, situated in a grove of trees on a tiny stream, was at an altitude of about 8000 feet, and the evenings were always spent before a greatly appreciated camp fire



TOKA MARKET

Underneath these two huge wild fig trees, growing in an otherwise almost treeless plain, the expedition's caravan camped for the night. The natives from the surrounding country gather here once a week to trade; otherwise the region is uninhabited

THE EXPEDITION FORDING A STREAM

Between Lake Swai and Mt. Chilali, at the foot of a deep and beautiful gorge, the expedition stopped for lunch. Here they found the first large trees seen in a number of days. It was here that they saw the first black and white *Colobus* monkeys

A LOCUST SWARM

While camped on the Hawash River in February, the expedition encountered the first locusts. Thereafter the party was continually running into vast clouds of these devastating insects. This was especially true near Mt. Chilali

Two days before we arrived at the base of Chicka Mountain, we came to the edge of a great plain. It stretched its length into the distance until Chicka and the southern end of the Chilalo range suddenly rose and cut it off. Great herds of cattle grazed apparently ownerless until we had passed, then heads emerged from the tall grass where the herders had secreted themselves, for these people live in constant fear of bandits all their lives. No attempt has been made agriculturally to develop the resources of that rich soil, used only for the grazing of their cattle. It lies untilled and barren where, in place of its brown grass, green stalks of corn and rippling waves of wheat could lift their heads to the hot sun.

Our camp was situated in a grove of trees on a tiny stream that leapt and laughed at our feet. Behind us Chicka Mountain rose, its sides dotted with the houses of the local nobility, for here lived Pasha Tasama, the chief of the Arrussi country. Though we had permission from the King to hunt where we pleased, yet it was necessary to present ourselves with this letter before each local dignitary. Accordingly we despatched our interpreter to the Chief to ask him to dine that evening. He returned with the news that the Chief was not there. The next morning we repeated the proceeding, with the same result. Having had past experience in trusting a subordinate to fulfil a mission, Morris LeGendre went himself. Three hours later he returned with the Chief's son and an invitation to call on Pasha Tasama the following day. The son, who dined with us that evening, gave a great deal of useful information about the nyalas. According to him, they were to be found on Ancha Mountain, which lay to the southwest of Chicka. After we

had seen his father in the morning, he would guide us there.

To pay a call in Abyssinia is a grave matter indeed. How many servants should one take? Are they to be armed, or would that be an affront? What should be the value of the present and when should it be given? These are matters that must be carefully considered, for the keynote of the Abyssinian is his pride. An insult is never forgiven, it will always rankle in his heart though he may appear as friendly as ever.

A visit to such a great chief unescorted by an armed guard would be unforgivable. Every rifle and side arm in the camp was brought into use, and we sallied forth as did the knights of old. Our reception was marvellous! Servants were dragged from their quarters and lined up at the gate. As we rode through, they saluted and bowed according to their own ideas on the subject. No two did alike; this, however, did not appear to worry them in the least. We were ushered into a round house made of mud and straw. The floor was of beaten clay, but covered with beautiful rugs. Opposite the door was a chair, and on either side of the chair were arranged low stools. Our party was seated at the right of Tasama and on his left sat his chiefs and retainers. We were served coffee and tala as speeches flew back and forth, all amounting to the same thing: What a marvellous country, we said. What magnificent people they were. And they, on their part: How glad they were to see us, how much they admired Americans. Then came the great question:

"Tell me," said Tasama, "what is your purpose in coming to my country?"

Then Morris LeGendre answered, "We have come to your marvellous country in order to collect specimens of the rare animals which are to be found only here. These we wish to take back with us. In America they will be very carefully prepared so that they will look as if life has been given back to them again. Then they will be placed in a museum, so that all the world may come and see, and praise Abyssinia, the home of these beautiful creatures."

THE BLUE-WINGED GOOSE
This bird is found only in the higher lands of Abyssinia

After this had passed through the hands of our interpreter, I doubt if the Chief knew any more than he did before. After one of these conversations, we said, "Hassan, what have you been saying?"

"Ah," said he, "the Chief asked me what a museum was."

"And what did you say?" Morris LeGendre asked.

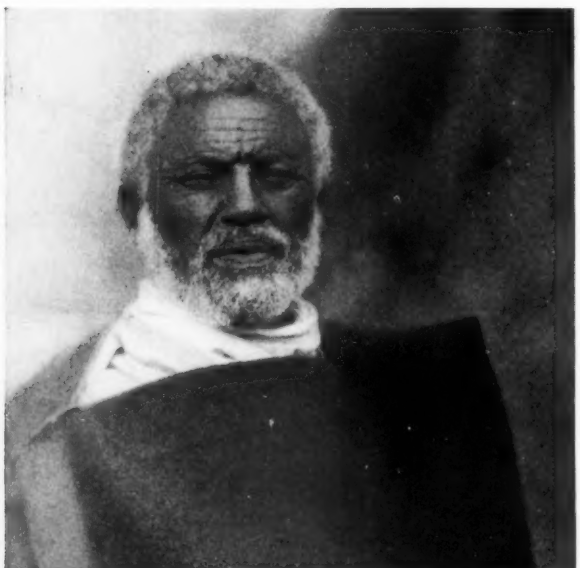
"I told him that it was a big room like a mission room at Addis Ababa, where you could go in and pray."

So much for interpreters!

That night Pasha Tasama sent us a goat as a present. We tentatively poked it in the ribs and sent back word that we hoped His Excellency would dine with us the following evening. The goat was killed and served in his honor, and even now I laugh when I think of his trying to chew that prehistoric creature. However, he was very polite and took his shoes off at dinner in honor of us. This is the greatest courtesy an Abyssinian can pay to his host.

Late the following day a pack train of four mules left our main camp at Chicka and disappeared amongst the rolling foothills in the direction of Ansha. The son of the Chief was our guide, and we four followed, thrilled with the knowledge that we were at last in the country of the nyalas which we had sought for so long.

TO BE CONCLUDED



CHIEF PASHA TASAMA
It was through the helpfulness of Pasha Tasama, chief of the Arussi country, that the expeditoin was successful in carrying out its plans

THE UNIVERSAL APPEAL OF THE AMERICAN INDIAN

Types of Indian Life in North America Illustrated by a Series of Paintings now on display at the American Museum

By CLARK WISSLER

Curator-in-Chief, Division of Anthropology, American Museum
Paintings by Arthur A. Jansson

IT is true that all North European peoples love the American Indian. He does not appeal so spontaneously to the Asiatic nor to the South European. Almost two centuries ago French and other European writers extolled the Indian of the forest as the ideal man; his existence was held up as the antithesis of the old worn-out civilization of the time.

It may well be that the ideal Indian of that period was just as far from reality as is the ideal Indian of today, but the interest of the American in the Indian is real. Accompanying it is a universal and spontaneous interest in mounds and stone implements. The farmer or the boy scout picking up an arrowhead is immediately carried back in imagination to a life different from the present; at this spot, he says, a man once hunted the deer, or perhaps launched an arrow at his enemy. In brief, the old, whether it be historic or prehistoric, makes an instinctive appeal.

So, by the very nature of the subject, the Indian and his past touches one of the basic interests in human life. He was on the ground when the explorers came upon the scene. The pioneers, traders, trappers, and settlers dispossessed him, and in the clash that followed, local history was made. In like manner the places where the Indian lived, the sites of first settlement, and the old trails, are all objects of interest.

Mounds, stone implements, prehistoric graves, are all associated with the Indian, because his ancestors, both near and remote, were responsible for them.

There is no more inspiring and romantic period in our history than the settlement of the great valley of the Mississippi. It thrills everyone to think of the great forests and plains, the hidden dangers that lurked therein, and the fearless, heroic, forward movement of our forefathers into this region. There are to be placed at convenient points along the Old National Road, extending from Cumberland, Maryland, to St. Louis, a series of statues commemorating the pioneer woman, my great-grandmother and doubtless yours also. These statues are symbolic of the regard for the outstanding events of the pioneer period, which future generations will cherish. The Indian is a part of this pioneer picture; he is the human element in the background against which the achievements of our great-grandparents are projected. Without them and without due regard to the life of their ancestors, the true life of the pioneer can never be shown.

It is not strange, then, that interest in the Indian is universal and that he is so fixed in the popular mind. Yet, as conceived in the popular mind, shown in pictures, and described in story books, he is not necessarily the real Indian. Thus, if the word "Indian" is encountered, one usually visualizes a tall, athletic figure, partly nude, arrayed in a

THE EASTERN WOODLANDS INDIANS

In the eastern portion of the United States and Canada, and as far south as Pennsylvania or Maryland, the native Indians developed a culture that sets them off definitely from those farther to the south and west. Their habitations were usually of bark, and were dome-shaped; their canoes were either dugouts or were made of birch bark; in addition to being hunters, they also raised corn and beans; they had not learned to weave cloth, though they made baskets and pottery; and they could hardly be called nomadic

magnificent headdress of eagle feathers, and grasping the indispensable tomahawk. Also, we expect him to be a fine horseman and to live in a tipi. The truth of the matter is that this is but one type of American Indian, the Indian of our western plains, whereas there are many others of contrasting costume and mode of life. For example, the Alaskan totem pole makers did not live in tipis, did not wear feather headdresses, nor did they ride horses; so there is little or nothing in their mode of life to suggest the Indian as seen in art and in motion pictures. So fixed, however, is the notion that the real Indian must wear feathers and live in a tipi that, when Indians appear for the entertainment of white people, they feel it necessary to assume such a costume and sometimes to carry a tomahawk. In other words, the feather headdress and its accompaniments have become the conventional dress suit of all Indians.

When the English settlers came to New England, they found a type of Indian more or less common to the whole St. Lawrence and Great Lake country. He lived in the forest and used canoes to carry him along the rivers and lakes. He did carry a stone tomahawk and dangled the scalps of enemies from his belt; yet he did not live in a skin tipi, nor did he

wear a graceful, drooping, feather headdress. On occasion, he tucked a feather or two into his hair, or set them in a row around his head. He wore moccasins and a robe, and thus resembled in part the Indian of the Plains. His method of fighting was also similar. The first Indians to figure in the fiction and art of our forefathers were these forest Indians. King Philip was one of these and so are the characters that enliven Cooper's tales.

As the white settlements of the Atlantic Coast spread westward, they encountered the Indians of Pontiac, Tecumseh, and Black-Hawk, all forest Indians, but some of them living upon the edge of the open grassland of the Mississippi Valley. Later, settlers began to push out into these plains, and thus came into contact with the Sioux, Pawnee, Comanche, etc. The history and romance of this ever-moving border is one of the fascinating phases of the story of the white man in America, and the Indian who plays the chief rôle in this is a composite of forest and plains types. It is this composite Indian type that is cultivated in boys' camps and similar organizations, the costume, and housing, being that of the Plains Indians, the woodcraft, and ideals, being chiefly those of the forest Indians. For art and romance this is well enough, but if one wishes to know the Indian he must recognize a number of other types.

THE INDIANS OF THE PLAINS

The culture of these Indians was based almost entirely upon the buffalo. They were nomads, following the herds. Their tipis and their costumes were of skins. With few exceptions they were not agricultural and were not users of boats, the circular and hide-covered "bull boat" of the Mandans being the only developed type

The American Museum is now preparing models and paintings to show in series the main types of Indians in the United States, viz., the Eastern Woodland type, the Indians of the Plains, the Pueblo dwellers of New Mexico and Arizona, the California type, and the Alaskan. If we add the Eskimo as a contrasting type, we have covered the range of the aboriginal life within the bounds of the United States and Alaska. The illustrations accompanying this article were designed to bring out the contrasts in these aboriginal American types.

As one reviews these sketches, it appears that two types were in part agricultural, viz., the forest Indians of eastern North America and the pueblo dwelling Indians of New Mexico and Arizona. Yet these Indians differed greatly, as the pictures show; the Pueblo, or town dwelling Indian, lived in a semi-arid country where game was less abundant than in the well watered forests of the east, so, as may be expected, the forest Indian was still a hunter rather than a farmer, whereas the Pueblo Indian was more a farmer than a hunter.

Another interesting aspect of this is that among the forest hunters the women did what farming was done, while among the Pueblo Indians the men did most of the work in the fields. These facts alone would suggest that hunting was the primary occupation in the east and farming the chief activity in the west.

One reproach often hurled at the Indian is that he made his women do all the hard work; this notion developed in the European mind because the Indian of the forest regarded the secondary work of farming as woman's work, whereas European standards held farming to be man's work.

Further, to the European, hunting was delightful sport, and the tendency was to view the occupational hunting of the Indian as nothing but sport, also. Among the Pueblo Indians the situation was reversed, as we have stated, in which case a disinterested white observer might have seen nothing wrong, but would, in fact, have commented upon the industry of both the men and women.

In the main, however, the Indian tribes of the United States and Canada lived by hunting and fishing and such wild plant food as came to hand. It was only among the Pueblo village dwellers of New Mexico and Arizona and a few tribes in southeastern United States that agriculture can be said to have been the chief support.

If the reader gives close attention to the pictures as a whole, he will note that the scenery is different or that each type of Indian life is in a different geographical region. This is one of the important facts to bear in mind when studying Indian life. The forests east of the Mississippi constitute one kind of country in contrast to the treeless country just west of the Mississippi.

Not only is the contrast observable in vegetation, but in animal life as well. Herds of bison ranged on the prairies and plains of the west, while in the forest were deer of several species. A moment's thought will make clear the necessity for different modes of hunting and housing as between the forest and the prairie. So, in a general way, we can say that different types of Indian life will be found in those parts of our country which show distinctive general geographical features.

The types of Indian culture shown in these illustrations are then to be taken as geographical types, and could serve as a study in the relation of man to his geographical environment.

Looking at this from another point of view, it appears that there are different types of Indians in the several geographical regions, because in each in-

THE INDIANS OF THE SOUTHWEST

The culture of these Pueblo Indians was essentially sedentary. They were agricultural, they wove cloth and made baskets, while their pottery was of a high type. They inhabited dwellings that in most cases were permanent, and gathered in communities sufficiently large to be called cities by the early explorers. Even today some of the old pueblos are inhabited as they have been for centuries. With the Pueblo Indians, the Apache are included, though their cultural characteristics were more like those of the Plains Indians

stance they have found a way to live comfortably by exploiting certain natural resources.

When the white man first set foot on these shores, he was confronted by new conditions, not only the country but the plants and animals were strange. The history of the first attempts at settlement recounts a number of tragedies, the white man starving where the Indian lived comfortably. The whites who did succeed did so because they learned from the Indian how to track and hunt in the forest, how to cultivate a garden, and do similar work. Perhaps few in this day and time suspect that the Indian had something to contribute to the civilization that was to be America, and still less in number are those who recognize the magnitude of this contribution.

As we have stated, the first task confronting the white colonists in the United States was to learn how to live in this new country. The first settlements were in the forests of the Atlantic seaboard. The Indian had lived there a long time and had acquired a technique for the purpose which is now spoken of as woodcraft. The details of this woodcraft were taught the first colonists by Indians and, while it is true that the colonists made some changes in them, the woodcraft of the

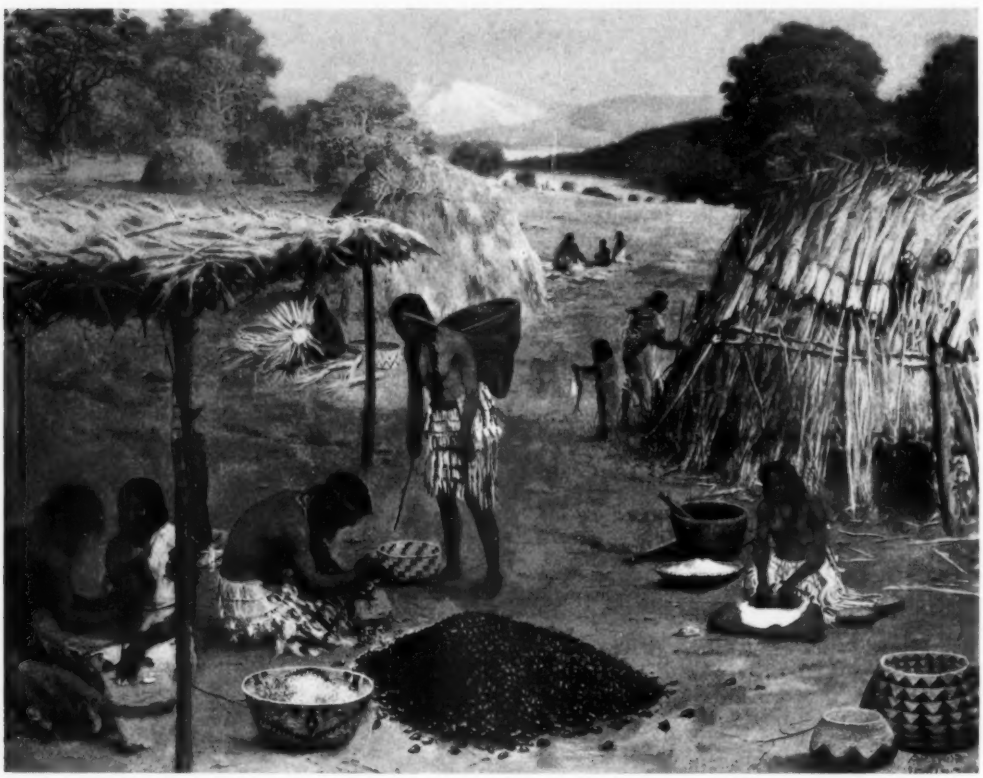
present as practiced by boy scout and other organizations is fundamentally that of the Indian.

Many Indian inventions were adopted with little change, as moccasins, snowshoes, birch bark canoes, toboggans, wigwams, tipis, and the like. The game of lacrosse was borrowed from the Indians. Along with these material contributions to the culture of the United States went certain concepts, as trail, warpath, war paint, scalping, counting coup, peace pipe, burying the hatchet, council fire, scouting, totem, and so on, all of which have enriched language and literature.

In the matter of geographical names the contribution of the Indian is conspicuous. At least twenty of the states comprised in the United States bear Indian names, while for rivers, lakes, and towns, the list of Indian names is in almost equal proportion.

In a less direct sense modern art has been enriched by the Indian, a large number of contemporary painters and sculptors working exclusively with Indian themes. Also the literature and folklore of the United States owes much to the Indian; he is the most unique and most fascinating character in fiction and border romance.

In general, to eliminate the Indian



THE INDIANS OF CALIFORNIA

Lower in the scale than other Indians were those of California, though their basketry had attained a considerable degree of perfection, and was often highly decorative. Despite this, however, their development along other lines was limited. Neither hunters nor agriculturists, they lived on acorns, wild seeds, roots, and fish. They never developed a boat, though their rafts—made of reeds—were in common use. Their habitations were hardly more than flimsy shelters made of brush

THE INDIANS OF THE NORTH PACIFIC COAST

The outstanding characteristic of these Indians was their extraordinary ability as wood carvers. Huge and highly carved dugout canoes, totem poles, wooden masks, and chests, all were examples of the wood carver's art. They wove excellent blankets, made highly decorative baskets, and lived in sturdy wooden houses. They were fishermen, drawing most of their food from the water

from the present culture of the United States would leave a great gap, would remove most of the non-European elements from contemporary American culture.

We have, however, omitted the economic contributions of the Indian. In general, a strong claim can be made for the fundamental character of economic factors; they are in many respects the foundation upon which governments rest. Food is, at least, indispensable. The Indian had developed the plant food resources of America to an unusual degree. Before 1492 the natives of North and South America had under cultivation some forty plants, many of which are now known to the civilized world; for example, alligator pear, lima bean, cacao, manioc, maize, peanut, potato, tobacco, and tomato.

The monetary value of these plants is enormous. As an illustration we may cite the estimated production for four of these plants in the United States alone; for the year 1927 it was as follows:

Maize	2,700,000,000 bu.
Tobacco	1,200,000,000 lbs.
Potatoes	400,000,000 bu.
Peanuts	860,000,000 lbs.

It would make a long story to enumerate all the ways in which the Indian has enriched American life and in

turn the life of the civilized world. In any case, our present interest is to take note of the several different types of Indian life to be recognized when one sets out to make a serious study of the subject. The exhibits in the American Museum are grouped in halls, as far as may be, to correspond to these geographical types of Indian life, thus facilitating comparison and contrasts. They are also in natural sequence, so that one may, in imagination, cross the continent of North America on a stroll through these exhibits. The pictures accompanying this article also may be viewed in geographical order, beginning with the Indians of the eastern forests and passing westward to California, thence to Alaska, and finally to the shores of the Arctic Ocean.

THE ESKIMO

These people were universally hunters and fishermen. During the summer they were migratory, sometimes following the caribou, sometimes making long journeys for wood from which to make implements and sledges. They depended upon dogs as draft animals, and during the winter lived on the ice while they hunted seals. Two interesting facts about them are that they were the only natives of America who learned to use the arch (which made possible the snow houses in which they lived during the winter), and they developed tailored garments to protect them from the excessive cold

SEA SIRENS

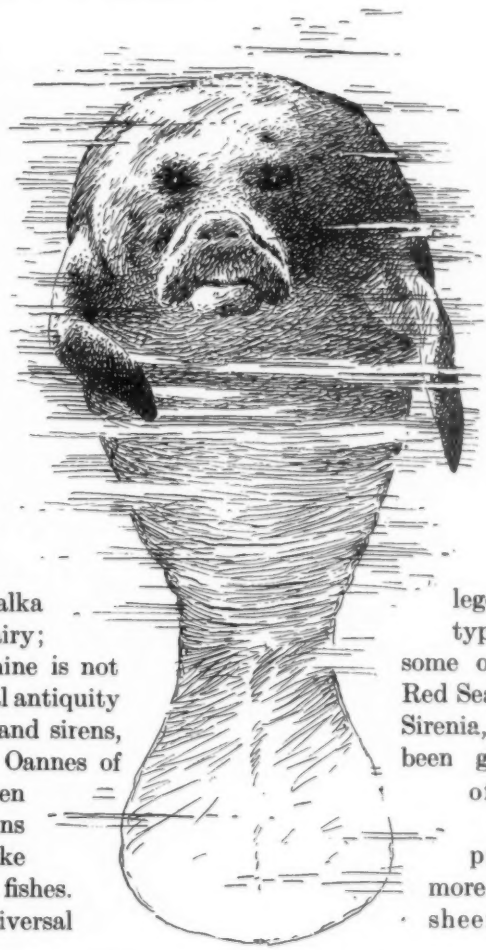
The Strange Mammals from which Came the Ancient Ideas of Mermaids and Sirens

By GEORGE GAYLORD SIMPSON
Associate Curator of Vertebrate Paleontology, American Museum

With Five Drawings by A. A. Jansson

THEY [the sirenians] have two breasts on the thorax and hair on the upper lip, two facts which, seen from afar when they raise their foreparts vertically from the water, can have made them somewhat resemble women or men, and have probably given rise to fables of tritons and of sirens." Cuvier, Le Règne Animal, 1st Ed., Vol. I, p. 273, 1817.

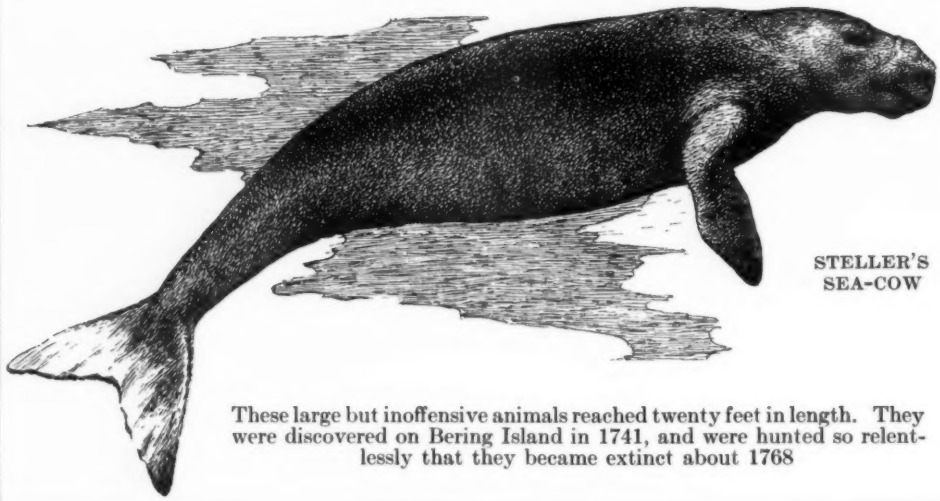
Among the most widespread of legends and myths are those of creatures half fish and half human. The mermaids of English legend are familiar to us from childhood, and similar beings are spoken of in many countries. The rusalka of Russia is a water fairy; the Lorelei of the Rhine is not dissimilar; in classical antiquity we find the Tritons and sirens, and still earlier the Oannes of the Babylonians. Even the American Indians have legends of fishlike humans, or manlike fishes. These almost universal mythical creatures vary from fishes that talk and reason to human beings that dwell under water but are otherwise like ourselves. One of the latter appears in some old Irish records as a saint. Most characteristic, however, are those which are fishlike below the waist and human above, the typical mermaids and mermen.



THE FACE OF A MANATEE
Homely and stupid, the manatee takes life placidly

The efforts made by oversober scientists to reduce such marvels to coldly reasonable origins have in a few specific cases been only too successful. A captured seal or a demented woman found wandering on the beach, seen through the mists of later years, may become mermaids. It has been repeated so often as to be rather generally believed that the sirens of Homeric legend have their prototypes in marine animals, some of them living in the Red Sea, to which the name Sirenia, or the sirenians, has been given in recognition of this possibility.

Similar legends have probably grown up more than once through the sheer ingenuity of the human spirit, for they appear among peoples who cannot possibly have seen or heard of these animals. Nevertheless, this is an interesting and quite possible explanation of the siren myth and we may believe it if we wish. Beware of



STELLER'S SEA-COW

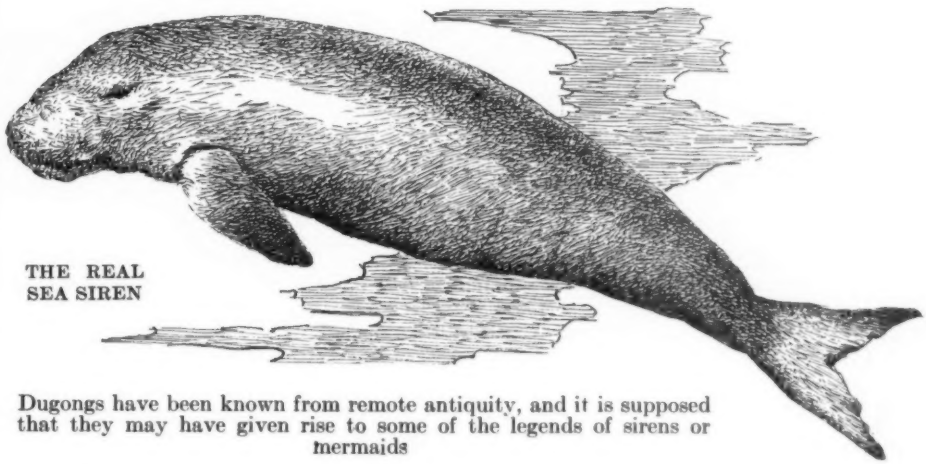
These large but inoffensive animals reached twenty feet in length. They were discovered on Bering Island in 1741, and were hunted so relentlessly that they became extinct about 1768

disillusion, however, for the sirenians are also called sea-cows (although, of course, they are really no sort of cows) and are as ugly and stupid as the sirens were beautiful and enticing.

And now I confess that the sirens were introduced here for their age-old purpose of luring the unwary. This article is devoted to sirenians and not to sirens, but the sirenians are strange and interesting on their own account.

There are and have been many different kinds of sirenians, some of which will be discussed in more detail, but all are of rather similar appearance. They live quiet lives in the water, from which they never emerge, and their whole appearance and structure is harmonious with these habits. The body is rather fishlike, but plump, and ending in a broad paddle or fin which is horizontal (as in the whales) rather than vertical. This fin is the chief means of swimming, and the hind legs, which we know to have been present originally, were useless and have so degenerated that no trace of them is seen in the living animal although there are internal vestiges. The front legs still have many uses and are retained, but modified into flippers. The head is extraordinary and rather grotesque. The ears are very small, and the eyes also are relatively minute or even slitlike. The snout forms a blunt, broad muzzle with stiff bristles. The upper lip is very coarse and blunt and may be split. The animals pick water plants by grasping them between the two halves of the lip. The body is apparently hairless, although a very sparse coat of small hairs may be found on closer inspection. Most of these creatures live in or near the sea, but they seldom venture into deep water and some of them are found far up the courses of large and relatively sluggish rivers. Their food is exclusively vegetable, consisting of succulent sea and water plants, and they are inoffensive, stupid animals, generally very shy once they have learned of man's evil intentions toward them. In size the living sirenians vary from the Amazonian manatee, about 7 feet long, to the Australian dugong, which may reach 15 feet, but Steller's sea-cow, now extinct, was as much as 20 feet in length.

Sir Thomas Browne encouraged conjecture as to what song the sirens sang. It may be rude to insist that their animal prototypes sing no songs, but are, in fact, almost voiceless and very unmusical.



THE REAL SEA SIREN

Dugongs have been known from remote antiquity, and it is supposed that they may have given rise to some of the legends of sirens or mermaids

Of the living sirenians the manatee is perhaps the most interesting to us. Although seldom seen, some of these animals still survive in Florida. This is the extreme northern limit of their range, but they also occur in the West Indies, and along the Atlantic Coast and up its rivers not only in Central America and in northern South America, but also in Central Africa.

The manatee was one of the first American animals to be made known to Europeans. Pietro Martire d'Anghiera mentioned it as early as 1500 as occurring in Santo Domingo, and Oviedo, Gomara, and many other early chroniclers also record its presence in the Americas. I do not know when the African manatee, which is very like our own although classified as a different species, first came to European attention, but apparently it was not described by scientists until the American form was well known. It is referred to in Adanson's *Histoire Naturelle du Sénégal* (1757) but at that time Senegal had already been visited by Europeans periodically for some three hundred years. The animal was, of course, well known to the natives and some of the earlier travelers probably mentioned it.

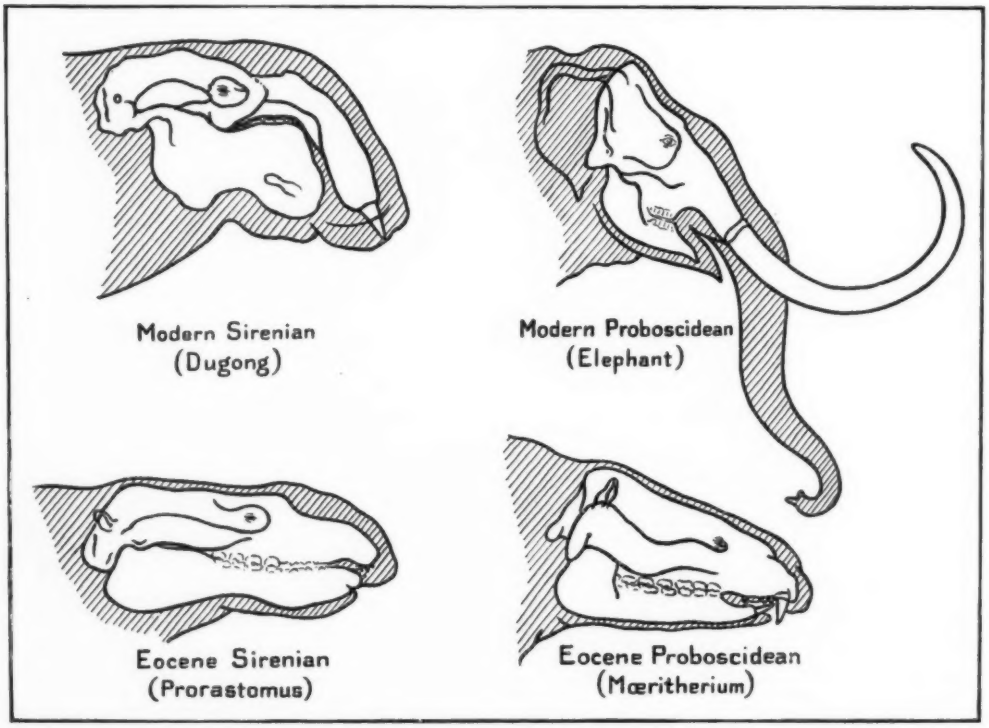
Poets have more than once cast aspersions on names, but the name "manatee" is involved in a bit of history unimportant, perhaps, but sufficiently curious to be of some interest. The English word is derived from the Spanish "manatí" which in turn, as all authorities agree, is of West Indian origin, coming from the Carib "manatui" or "manattoui." Now, it is a peculiar fact that certain West African negroes of Mandingo stock (their own name said to be derived from this same word) call their manatee "manti," "mande," "mani," or by some variant on this root. The Carib "manatui" may have been adopted by the Indians from the "manti" of Mandingo slaves and hence carried back across the Atlantic by the Spaniards. This ingenious explanation has been seriously proposed, but the remarkable similarity in the Mandingo and Carib names is probably only a coincidence, for the name "manati" appeared in Europe as early as 1500 and "manatui" must have been current in the Caribbean before that date.

Manatees are especially characterized by their split upper lips, absence of tusks, grinding teeth continually replaced from

the rear throughout life (a unique arrangement), and rounded tail fin.

The dugong, living in the Red Sea near the oldest western civilizations, must have been known from remote antiquity, although the oldest references are rather ambiguous. Some scholars hold that the "thachash" covering the Israelite tabernacle was the hide of the Red Sea dugong. An inscription of Sargon at Khorsabad speaks of the king's having built "palaces covered with the skin of sea-cows" and it is probable that the word "sea-cows" was used in the modern sense, rather than for seals as has also been suggested. The earliest modern and unequivocal first-hand reference to the dugong is apparently that of Führer von Haimendorff, who visited the region of the Red Sea in 1565. Dugongs, of which there are three distinct species, live not only in the Red Sea but also along the shores of the Indian Ocean and adjacent waters from Madagascar to Northern Australia and the neighboring islands to the Philippines. The name dugong is of Javanese or Malayan origin. This is one of the few instances, like *Hippopotamus* and *Bison*, of identity between common names and scientific names, for *Dugong* is the technical name of the genus, although it has also been called *Halicore*, a name derived from two Greek words meaning "sea-maiden," another allusion to the supposed connection between sea-cows and sea sirens or mermaids.

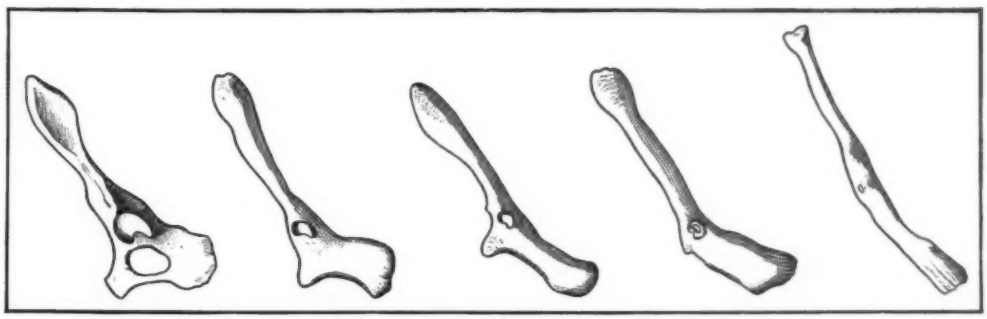
If the sirens really were glorified sirenians, their origin must be traced to the dugong, the only sirenian with which the ancients can have been acquainted.



SEA-COWS AND ELEPHANTS

The oldest sirenians and the oldest proboscideans (lower figures) were rather similar in appearance and were probably derived from a common ancestry. Today their descendants are very different, for they have been progressively modified in keeping with their diverse modes of life. To bring out the structural changes in the heads of these animals, these drawings have not been made to scale

To the impartial eye of science no creature is repulsive and no action to be judged from the standpoint of human virtue, but one cannot help a feeling of regret that these sirens are distinctly



HOW THE SEA-COWS LOST THEIR HIND LEGS

The remote ancestors of the sea-cows had normal legs and walked on land, but, as they took to life in the water, their hind legs became smaller and smaller until now they are represented only by internal vestiges. This progressive loss, one of the most striking evidences for evolution, is well shown by the hip bones or pelvis of fossil and recent sea-cows. The pelvis of the oldest known form (on the left) is like that of a land mammal. In the progressively later forms, as shown here, it becomes much altered, and the attachment for the thigh bone becomes small and functionless, until in the recent dugong (on the right) the pelvis is a long rod of bone of no use in locomotion

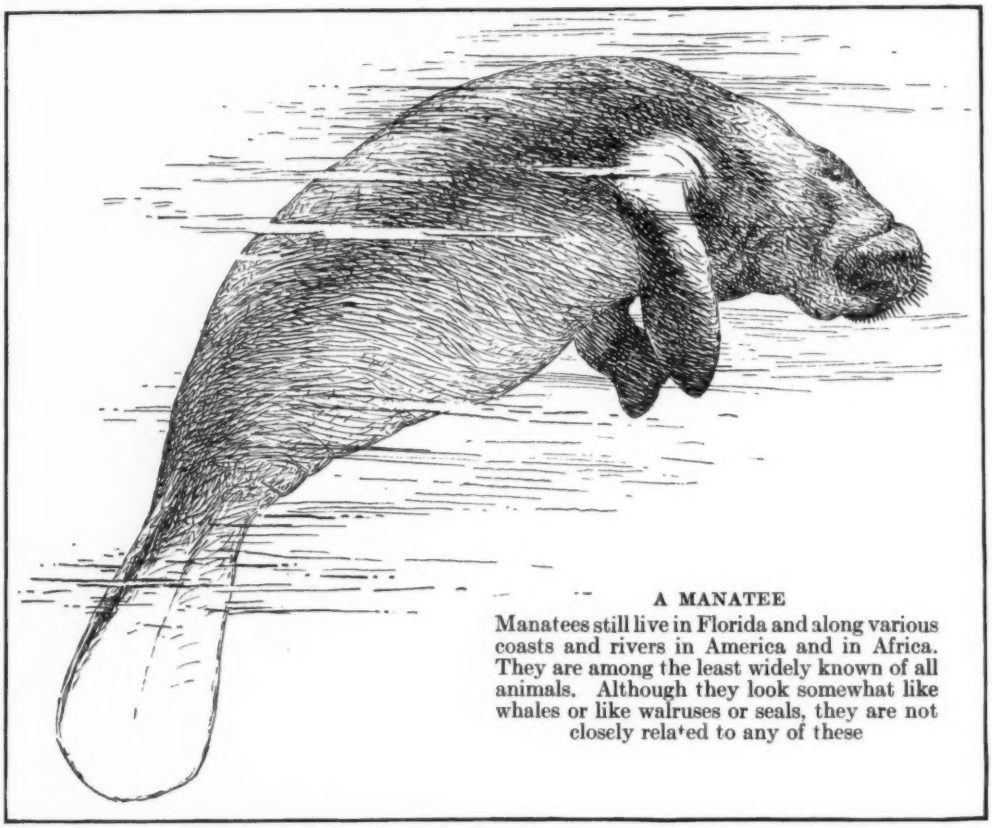
unlovely, or a feeling of surprise that they possess the virtue of almost passionate attachment to their young.

Dugongs differ from manatees in many ways, but most obviously in the possession of two tusks, larger in the males, in the small number and degenerate character of the grinding teeth, and in the tail which is forked rather than evenly rounded.

These two, dugongs and manatees, are the only kinds of living sirenians, but until about one hundred and fifty years ago there was a third, Steller's sea-cow or rhytina.

The history of knowledge of Steller's sea-cow is shorter, more exactly known, and more tragic than that of the manatees or dugongs. In 1741 the Danish explorer Vitus Bering, under a commission from the Russian government, took refuge on the island off the coast of Kamchatka which now bears his name. During the winter 1741–42 Bering himself and many of his men died, but part of the company survived, subsisting chiefly on the flesh of a bulky but helpless sea-cow then abundant along the shores of this island. On the return of the party, this animal was described by William Steller, a naturalist who had accompanied Bering. There were various reports of its former existence over a wider area in the North Pacific, but at this time it was confined to Bering Island and to the smaller nearby Copper Island, both of the Commander Group.

The work of Steller inaugurated the fur trade of the Bering Sea and during the following years many exploring and sealing parties, chiefly Russian, visited the islands and lived largely on the flesh of the sea-cow. In 1754 it was extinct on Copper Island but still fairly common on Bering Island. The last of these strange animals was probably killed in 1768. A later date is sometimes given, but this seems to be the last actual record of the animal seen alive, and a later party is said to have found none living in 1772. In any event, there is no doubt that Steller's sea-cow has gone the way of the dodo and is totally extinct, a fate which long has threatened any animal whose death is of any use to man, especially those so defenseless as this great stupid creature.



A MANATEE

Manatees still live in Florida and along various coasts and rivers in America and in Africa. They are among the least widely known of all animals. Although they look somewhat like whales or like walruses or seals, they are not closely related to any of these

A number of skulls and skeletons have been discovered since its extinction and are preserved in various museums.

Aside from its great size, Steller's sea-cow was especially characterized by the absence of any functional teeth. Its tail was forked and in general it was rather similar to the dugong, but its head was smaller in proportion to the very bulky body.

Although they occur in our own country, living sirenians are less known popularly than perhaps any other group of animals. Their past history is still less widely known, but it is one of the clearest and most interesting examples of some of the principles of organic change and adaptation.

In Egypt in rocks which were formed near the beginning of the Age of Mammals have been found the remains of an animal ambiguously named *Eotherium* (more properly *Eotheroides*), the dawn beast. This is a sirenian, but one very unlike those living today. The whole structure is more primitive, more like that of other mammals. The teeth are much less modified than in later specimens, agreeing in number and to a less degree in form with characteristic primitive land mammals. Most extraordinary is the fact that this animal had functional hind limbs, as shown by its small but complete and normal hip bones.

This animal and others of about the same age but less well known cast much light on the origin and relationships of sirenians. The naïve idea that sirenians are "fishes with hair" was outgrown more than a century and a half ago. They are warm-blooded, their young are born alive and suckled by the mother; in other words, they are true mammals. Like the whales, which are also mammals,

they are extremely modified for aquatic life. In fact it was once commonly supposed that they are closely related to the whales, but the fossil sirenians clearly show that this is not the case. They are related not to the whales but to some of the hoofed mammals, apparently especially to the elephants.

It is a far cry from the elephant to the dugong today. Two less similar mammals can hardly be imagined, yet they represent continuous development in two directions from a common ancestor, if the evidence of the more or less intermediate fossil types is rightly understood. The ancestral group must have included small animals, quadrupedal, living on land. One line of descendants remained on land, developed tusks and a proboscis, became large and heavy—the elephants and their allies. Another line, perhaps living in marshes or along lagoons at first, became increasingly committed to the water where it sought its food. At first amphibious, it later became so fully aquatic that even a temporary stay on land is now impossible. The hind legs were lost, a tail fin developed, the other sirenian characters slowly acquired.

The course of many of these changes can be traced in the series of fossil sirenians of different ages. The oldest fossil forms, already mentioned, had functional hind limbs. In later types the hip and hind limb bones are progressively reduced. The front part of the skull in most cases becomes turned downward, tusks are usually developed, the nasal openings are placed farther back on the head, and other changes, too numerous to specify, take place, for the most part in adaptation to aquatic life and the available types of marine plant food.

Most of the known fossil sirenians are dugongs, in a general sense. That is, while differing in details and in the extent of their specialization from the living dugongs, they resemble the latter more closely than they do any other living types. From these we learn that dugongs were once much more widespread than at present. They are found not only in Egypt, and in various places in Europe—Italy, Austria, Germany, France, Belgium, England—but also in the West Indies, the Atlantic Coast of the United States, and even in California. At one time primitive dugongs must have lived along the coasts of most or all of the continents although they are now almost confined to the Indian Ocean.

Steller's sea-cow was probably only a specialized and local descendant of one of these early types of dugongs which became very large and lost its teeth.

One of the most curious facts about this history is its surprising incompleteness in one respect: the early ancestry of the manatees is quite unknown. In Florida, for instance, where manatees are among the most striking of animals today, one would surely expect to learn something of their ancestry. Collecting in the older rocks of that state has indeed revealed several types of fossil sirenians, but before the relatively recent Pleistocene Epoch, or Ice Age, these are all dugongs and cannot have been ancestral to the manatee. Where the manatee originated and how it came to replace the dugongs in the Atlantic Ocean is one of the many mysteries of this strange group of animals.

From a distance the crater of Ngorongoro looks like a long, low ridge

THE GRASS TRAILS OF EAST AFRICA

The United States Department of Agriculture Sends an Expedition to East Africa—Research Concerning the Possibility of Raising the Food Grasses of East Africa's Great Grazing Lands on the Farms and Ranches of the United States

By LEONARD W. KEPHART

Senior Agronomist, Bureau of Plant Industry, U. S. Dept. of Agriculture, Washington, D. C.

EVER since the day, more than twenty years ago, when Theodore Roosevelt laid aside the burdens of high office and departed for Africa on the world's most famous hunting trip, the words "East Africa" and "big game" have had almost a synonymous meaning. One means virtually the other. In the popular mind there is probably no mental picture of East Africa except as the home of lions, elephants, and ostriches, for the glamorous tales of high adventure on the game trails have almost blinded us to other features of that very fascinating land.

For a region that is as commonly visited and as widely discussed as East Africa there is a surprising lack of geographical information. The country has been traversed many times in all directions, yet no very useful maps have, until quite recently, existed. Accurate details as to rainfall areas, topography, roads, and settlements are difficult to obtain. As to adequate scientific data on soil types, vegetation distribution, growing seasons, and the like, they simply do not exist.

This unsuspected state of affairs immediately became apparent when preparations were begun, early in 1927, for an expedition by the United States Department of Agriculture to East Africa for the purpose of collecting the seeds of African grasses. The expedition had been in mind for some years, and when funds rather suddenly became available, we found ourselves confronted with a disconcerting lack of information. Hurried inquiry in libraries and among travelers who had been in East Africa failed to produce very tangible results, and we

finally sailed from New York with only a hazy kind of idea of what lay before us. Later we learned that much advice that would have been invaluable to us could have been obtained at the American Museum of Natural History, but unfortunately this source was overlooked. By the rarest good fortune we arrived in East Africa at almost exactly the best season for our purpose—the middle of June.

Our task was to collect the seeds of all the grasses upon which the great herds of wild and domesticated animals in Africa subsist. Some of these, it was hoped, would prove useful when grown on farms and ranches in the United States.

Strangely enough, although East Africa is one of the greatest grazing lands that the world has ever seen, the identity of the grasses that grow on its plains and in its glades was practically unknown. A few of them had been given botanical names, but their distribution and the extent to which they were a factor in the livelihood of the animals was very much a mystery. We were working therefore in a virgin field.

The first thing that any young expedition does in East Africa is to go five hundred miles up-country by rail to Nairobi. This brings one up into the highlands away from the heat on the coast and into the heart of the game country and the settled areas. In Nairobi one settles down for a few days in one of the very comfortable hotels while one looks around and gets the lay of the land. At first the strangeness of the scene and the unaccustomed manners of the country are rather overpowering, but by the end of a week one has picked up a few words of Swahili, acquired a native "boy," listened to a great deal of excellent advice,

A WATER HOLE

In the dry season water is obtainable only at the isolated water holes which are scarce, and the expedition had to depend on these for its water supply. To such spots animals come for miles around. The water hole pictured here is more desireable than many

A WELL-DEVELOPED SECTION OF EAST AFRICA
This group of buildings forms a part of the Scott Agricultural Substation of the Kenya Department of Agriculture. It is located at Nairobi

ELEPHANT GRASS
Vast areas of Central Africa are covered with giant growth. Travel through it is not only difficult in itself, but is apt to be hazardous owing to the possible presence of elephants and buffaloes

and purchased a few items of equipment, most of the latter of which, to be sure, is later discarded. Within ten days one is beginning to lay plans for a tentative foray out into the "blue."

Fortunately for us, the immediate vicinity of Nairobi proved to be an excellent locality for collecting grass seeds. The town lies at the western edge of the famous Athi Plains at a point where they begin to rise into the Limuru highlands. The business part of the town is on the plain with the residential area spread out over an expanse of several miles in the surrounding hills. In one direction are the dry plains composed of a black, waxy, soil, covered with tall waving grass and dotted with little thorn trees. In the other direction are the rolling uplands of deep red soil, which, because it is entirely lacking in organic constituents, becomes as dry as powder when the rains cease and incredibly sticky as soon as the rains

resume. The red soil, however, is very fertile, and originally supported a heavy growth of wild olive, podocarpus, and other forest trees. These are disappearing rapidly now that the hills are given over to the Kikuyu native reserve and the European coffee farms, with the result that the timber problem in Kenya is acute. However, the opening of the forest has brought in an abundant growth of the luxuriant "Kikuyu" grass, one of the great sod-forming grasses of the world. Other grasses abound in the well-watered hills, and we were able to collect seeds of more than forty species without going more than five miles from Nairobi.

At the end of a month we were ready to be off on our first real "safari." As a preliminary test of ourselves and our equipment, we had decided to visit the Aberdares Mountains, a bleak, uninhabited highland some eighty miles to the northwest. We were particularly anxious

THE EUPHORBIA OR CANDELABRA TREE

Vegetation in East Africa sometimes grows to a grotesque size. This tree is a close relative of the tiny, weedy spurge that is found in American lawns

IN THE NATIVE RESERVE ON KILIMANJARO

Tanganyika Territory has not undergone the development by white men that has so changed Kenya colony, but the natives are coming more and more into contact with the outside world

THE HIGHEST GRASSLAND IN AFRICA

Possibly in the whole world there is no higher grassland than this rocky stretch near the summit of Mount Kilimanjaro. The summit in the distance is hidden by a snowstorm

ON THE SIDE OF KILIMANJARO

This enormous extinct volcanic mountain rises at the southern edge of the great grasslands of East Africa. The giant heather in the foreground of this picture stands ten feet high

LOOKING INTO THE CRATER OF NGORONGORO

In this crater which is twelve miles across and which contains lakes, forests, marshes, and grasslands, live scores of thousands of game. This unique spot is now a game preserve

KILIMANJARO FROM THE RAILROAD STATION OF MASHI

The snow-capped peak at the left is nineteen miles distant from the town in the foreground, and rises 17,000 feet above the elevation of this railroad terminal

KIKUYU "SHAMBAS" OR GARDEN PATCHES

The Kikuyus are an agricultural people who raise corn, beans, and bananas. The shrubs in the middle distance of this picture are castor bean trees, the oil of which is used by these natives as an ointment as well as an edible oil. The "fences" are of living grass

to obtain the grasses that grew on the high mountains because only those would have experienced the cold that they would have to endure in America.

In looking back at that first short safari I smile at the great earnestness with which we made our preparations. Later we would start off on much longer and more difficult trips quite cheerfully and at an hour's notice, but that first jump out into the blue was a serious affair. We were about to face the mystery of Africa.

As a matter of fact, travel in Africa, for two tenderfeet, was not without an element of danger. The grass trail follows the game trail, and where the game trail goes there is certain to be more or less of a hazard. Old-timers learn to anticipate difficulties or to avoid them, but tyros like ourselves were liable to blunder into situations that were disagreeable, to say the least. For long distances travel was likely to be through country uninhabited except for wandering Masai tribesmen and wild beasts. Food had to be carried along. Water occurred only at isolated water holes. Should anything happen to the motor car, as it frequently did, there was no one to call upon for help. If the petrol gave out, we would have to walk. If a rhino came charging out from behind an ant hill or a lion invaded the camp at night, we would have to shoot. If we came down with fever, as we were certain sooner or later to do, we would have to depend on our own doctoring. None of these prospects were conducive to levity in those initial preparations.

By dint of much good luck and some good management the Aberdares trip came off without mishap. We climbed for hours through dense forests of magnificent big cedar trees, where the mud in the

path was punched full of enormous footprints made by passing elephants. Occasionally the bark of a tree would be rubbed smooth eight feet from the ground, where an elephant had stopped to scratch his back. Great piles of rhino droppings showed where these cantankerous beasts had just passed by. The long, white hairs of a *Colobus* monkey under a bush were all that remained of a leopard's feast. At last we came out on to great moorlands of grass and sedges. Here a death like silence prevailed. In two days we saw not even a bird, and even the wind moving the grass made no sound. Gigantic heathers and senecios grew in the more sheltered places and gave a fantastic effect to the weird scene. A cold mist blowing across the heights added discomfort to the eerieness of the place, and we were glad when we plunged once more into the cedar forest and began the descent to the warmer and more friendly lowlands.

These cold, forbidding moorlands are a characteristic feature of the upper reaches of all the African mountains. They reach their extreme development perhaps on the Ruwenzori range, the almost impenetrable, rain-drenched mountains that lie on the border between Uganda and the Belgian Congo. They are found, however, on all of the tropical mountains, and represent a real barrier to exploration of their summits.

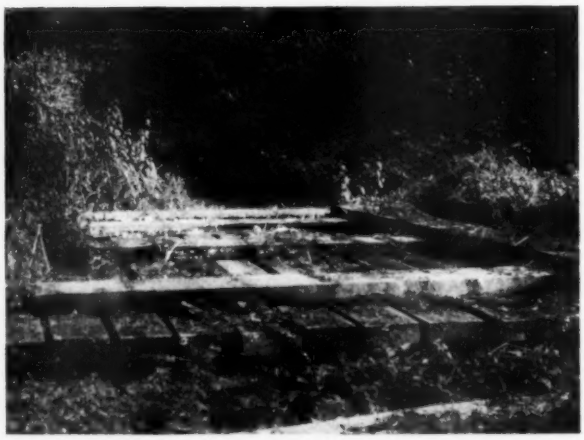
From the Aberdares we turned our attention to Kilimanjaro, the overlord of African mountains just over the Kenya border in Tanganyika. Kilimanjaro is nearly twenty thousand feet in height and, because it rises from a plateau of only about twenty-five hundred feet, shares with Mount McKinley the distinction of being the loftiest actual mountain peak in the world. On its slopes can be found

A KIKUYU WOMAN

The load on her back is *Themeda* grass, intended for the thatching of her hut. This is the only purpose for which these people harvest the grasses of their region

A RELATIVE OF THE "FOXTAIL" WEED OF OUR CORNFIELDS

(*Above.*) *Setaria sulcata* is a fine forage grass that grows in moist places. Its American cousin is sometimes known as "pigeon grass"

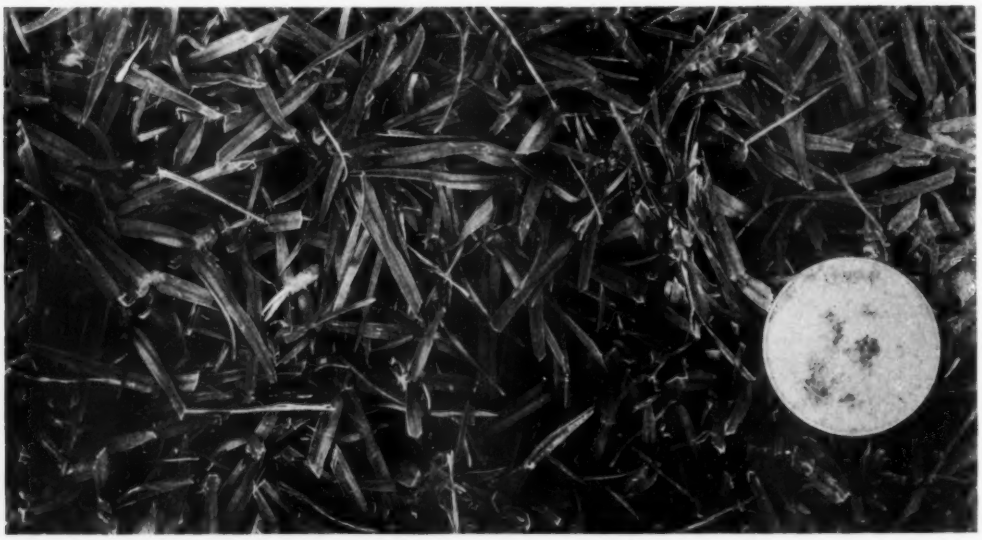


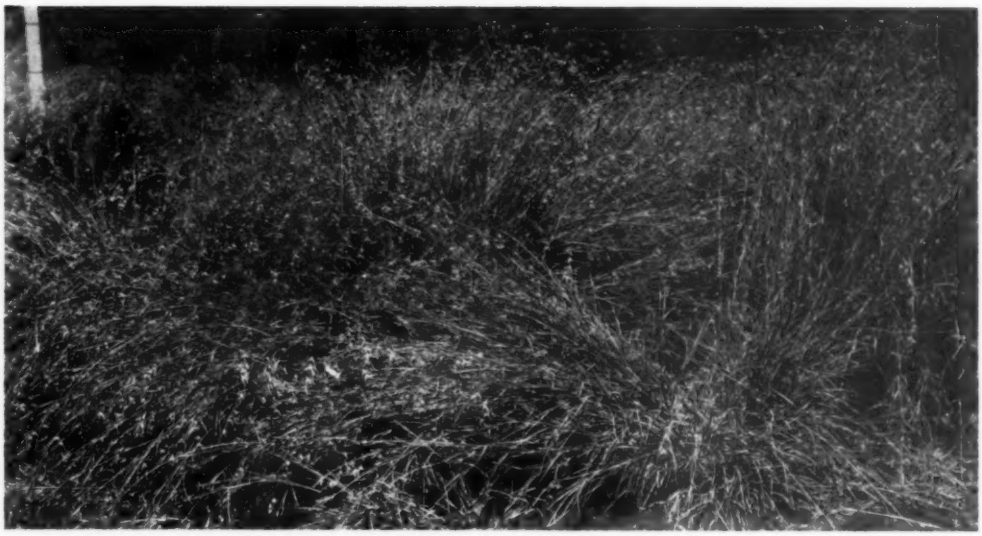
EAST AFRICAN CEDAR

(*Right.*) Though these cedar planks have been covered by jungle growth for eight years, they are still sound. Other woods would have decayed in a month

KIKUYU GRASS

(*Below.*) *Pennisetum clandestinum* is the predominating grass in the highlands of East Africa, and is one of the finest sod-forming grasses in the world





THE MOST NUTRITIOUS GRASS OF THE AFRICAN PLAINS

(*Above.*) *Themeda triandra* is not only the most nutritous but is also the most abundant grass of the region

NATIVE PORTERS

(*Left.*) The Ruwenzori Range is one of the wettest spots on earth, and toward the top is very cold and disagreeable. The porters demanded triple pay before they could be induced to make the journey

AN AFRICAN FOREST

(*Below.*) Most of the forest trees of East Africa are of little commercial value, with the result that structural timber is very scarce

the widest range of flora of any spot of equal area on the globe. As a British officer remarked, "You can throw a snow ball from the top of it and knock a coconut off a palm tree at the base."

Toward the top of Kilimanjaro, in the saddle between the two summits, we found what may be the highest vegetation to be found on earth—a little species of fescue grass lodged among the rocks of the Kibo summit. Kilimanjaro is nearly within sight of the Equator, and summits of eighteen thousand feet, with sufficient rainfall to support vegetation, are not common in that latitude.

From Kilimanjaro we undertook a long, hard safari to the great extinct crater of Ngorongoro, two hundred miles by trail to the west. A certain legendary interest attaches to Ngorongoro, for its twelve-mile bowl is said to be the home of incredible numbers of wild animals. Naturally we were anxious to visit the place because great numbers of animals meant great quantities of grass. To add to our curiosity, it had been reported by T. Alexander Barnes, in his book, *Through the Great Crater Land to the Congo*, that the floor of Ngorongoro was carpeted with a luxuriant clover, the only reference to clover in East Africa that we had ever seen. A short time after Barnes visited the place, it was explored by Mr. James L. Clark of the American Museum, and his wife, who were the first Americans ever to reach it.[1] Since then it has become a lodestone for hunting parties, who, however, have so overshot the herds that Ngorongoro has recently been proclaimed a game reserve and further shooting is prohibited. Not even Jackson Hole, in Wyoming, approaches Ngorongoro as a natural game sanctuary.

We reached Ngorongoro on foot after an eight-day safari. From a distance the great crater looked like a long, low ridge, rising from the plains, but on climbing the ridge, we found ourselves looking down into a gigantic hollow more than a thousand feet deeper than the plains around it. To the eye it seemed merely a broad, flat plain, surrounded by a mountain wall, but when the glasses were brought to bear, we saw forests and salt lakes, swamps and rolling hills, and literally myriads of grazing animals, chiefly zebras and wildebeest. Later, in walking across the floor of the crater, we found ourselves passing for hours through tremendous herds of animals, which parted in front of us, galloped madly to the rear and closed in again behind. Even the bands of lions that infested every swamp failed to make appreciable inroads on their numbers.

Unfortunately we found no sign of the clover that we had come so far to find. The grass of the crater was chiefly a species of *Cynodon* closely related to the Bermuda grass that is common in our Southern States. At intervals there were areas of *Themeda triandra*, the ubiquitous oatlike grass that affords the chief grazing of the African plains. For days we searched for the clover without success, while our food supply for ourselves and our porters rapidly approached the danger point. At last, just as we were about to give up and return empty-handed, we found a fine clover growing along the southern rim. I do not know whether this was the clover described by Barnes, but it was the most promising clover that we found anywhere in Africa.

The second highest mountain in Africa is Mount Kenya, a vast pile rising sheer from the plains exactly on the Equator, eighty miles north of Nairobi. In company with an official of the Kenya Department of Agriculture, we climbed to the base of the snow-covered pinnacle. Here again we found the moorlands, this time composed of great tufts of grass which stood on pedicels three feet tall. The only means of passage was to jump

[1] See "The Highlands of the Great Craters," By James L. Clark. NATURAL HISTORY, May–June, 1924.

like a chamois from one teetering clump to the next. If, as frequently happened, one of us failed as a tight-wire equilibrist, he plunged to his knees in ice-cold, oozy muck. In three hours we made approximately a mile, then the freezing fog shut down and we had to return to our camp, where we froze all night on the Equator.

Our last safari was far to the west—to the range of Ruwenzori. We did not attempt to climb to the summit. That is a task for elaborately equipped mountain climbers and has been accomplished only three times, the last by an American party, in 1928. We did, however, climb to the top of one of the passes. From a jutting spur of the mountain we could look far across the wilderness to the south. A broad expanse that seemed to be a snow field marked the waters of Lake Edward. Beyond them, a hundred miles or more from where we stood, rose the faint blue outline of a majestic peak. We had hoped that we would see that peak, for it marked the final resting place of a gallant man. A year before, to that very day, Carl Akeley had laid down his life on the slopes of Mount Mikeno.

It seemed a fitting place for our little journey to come to an end. With such facilities as we could, we each, in his thoughts, saluted his memory. The brooding stillness of the jungle is his requiem.

There will be many more expeditions to East Africa. The wealth of its flora is scarcely imagined. But the days of its primitive wilderness are rapidly passing into history. It is good that among those who witnessed the passing were men like Akeley who, seeing it, appreciated, and in appreciating, recorded.

A BAOBAB TREE

The queer objects in the branches of this tree, sometimes known as the cream-of-tartar or the elephantiasis tree, are native honey boxes

WHAT PRODUCES SPECIES?

Recent Laboratory and Field Work Give a Solution to a Problem of Long Standing

By G. KINGSLEY NOBLE

Curator of Amphibians and Reptiles, and Experimental Biology, American Museum

ONE of the most recent developments in museum work is the attention being given to living material. In some cases this results from the interest of the public in living as well as in mounted specimens. Hence, combination zoo-museums are being established. In most instances, however, the condition has arisen because the curator finds himself unable to answer many fundamental questions concerning his material without reference to live specimens. The importance of live material is well shown in the recent work which has been done on that old and often debated question: What produces species?

In considering the question of species origin, attention must be focused first upon the chromosomes, or the dark-staining bodies of the egg nucleus, for these are known to be the bearers of all the hereditary characters received from the maternal parent in most animals. Further, chromosomes make up the bulk of the head of the spermatozoön, the only material received from the paternal parent, and hence must include the principal if not the only hereditary factors derived from the father.

Geneticists and cytologists have shown that when changes or mutations occur in the determiners in either eggs or sperm, individuals are produced after fertilization which differ in one or more characters from their parents. The many races of pigeons, for instance, have arisen by mutation from the rock pigeon of Europe. Is this mutational change in the domesticated pigeons the same phenomenon as evolutionary change among pigeons in nature? If not, what other change in the chromosomes, since from the nature of the reproductive mechanism it must be in the chromosomes of the male at least, could possibly produce an evolutionary change?

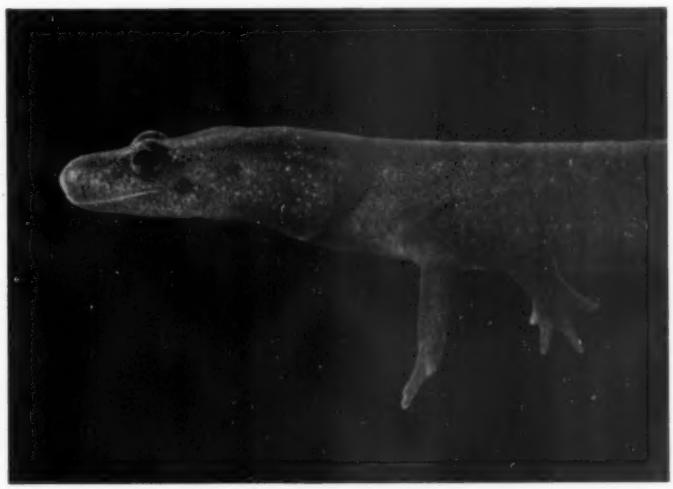
Darwin was familiar with large mutations, but he rejected them as a possible source of species formation. He appealed to the small heritable variations found in all species of animals as furnishing the material for species production. Modern genetics has demonstrated that these small differences are also due to chromosomal changes and they arise and are inherited in the same way as the large heritable mutations. Where multiple factors determine the presence of a single character, the latter may show great variation with only the slightest difference between the various grades. In brief, the gradual modification of a character and a discontinuous change have exactly the same basis, namely, mutations in the genes or determiners lying in the chromosomes.

In view of this fact, the recent work of geneticists is of the greatest significance to naturalists. Muller and others have shown that X ray and radium could induce mutations in both animals and plants. Very recently Goldschmidt found that exposing the eggs of fruit flies to a temperature of 37°C for ten to twelve hours produced many new types of flies which bred true. Babcock and Collins found that fruit flies placed near radioactive rocks in nature doubled their normal rate of mutation. There are many places in the tropics where the eggs of fruit flies would be subjected to temperatures of 37°C, and other regions where radioactive minerals form accumu-

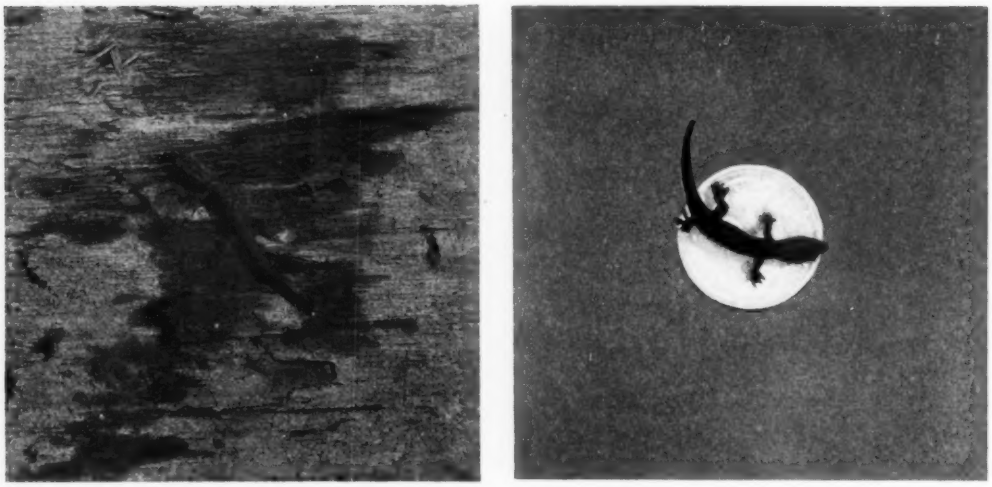
THE CAVE SALAMANDER
Typhlotriton, reared in the dark, becomes blind less than two months after metamorphosis

lations. The explorer going into the field today may look upon the environment as having a direct influence on the rate of evolution and may take steps to measure these physical factors.

Is the effect of the environment merely to stimulate the rate of mutation? One of the most perfect adjustments of an animal to its environment is found among the permanent cave inhabitants which are frequenty blind and colorless. Naturalists have assumed that this blindness was hereditary and have wondered why the only blind salamanders are found in caves. Mrs. C. H. Pope and I have reared the young of one cave species, *Typhlotriton*, which differs from the other cave forms in retaining both eyes and pigmentation until the time of metamorphosis. We found that if we reared young in the dark the eyeballs eventually withdrew slightly into the head, the eyelids fused to the same degree found in nature, and the retina which had been functional during youth underwent degeneration. Controls which were reared at the same temperature in the light, retained and further developed functional eyes. The lids never fused and the retina never dwindled. Further, light-reared individuals were more pigmented than dark-reared ones. *Typhlotriton* had been losing its eyesight during every generation probably for many centuries—there is no fossil record—and yet it was potentially able to retain and elaborate functional eyes if the stimulus (direct or indirect) of ordinary daylight was available to it. The unfavorable environment of the cave had not been able to produce any permanent effect on the eyes or coloration of this salamander. Many animals owe the full expression of any



THE INFLUENCE OF LIGHT
The same species reared in the light retains and further develops both its eyes and its pigmentation



A PROTECTIVE DEVICE

The young Haitian lizard *Sphærodactylus difficilis* has a tail tipped with white. Since the tip is frequently agitated, enemies are attracted toward it instead of toward the vital head region of the lizard. The tail drops off when seized, but nature does not provide for a second attack in the same way. A new tail grows out but is devoid of the conspicuous white tip. The lizard with the regenerated tail is standing over a disk the size of a dime. The lizards shown above were raised from eggs in the American Museum's laboratories

character to the influence of a favorable environment during development, but there is no evidence of an environmental effect becoming inherited.

It is a commonplace that animals are adapted to their environment. If they were not in more or less harmonious relation with the habitats in which they live they would eventually succumb. Darwin suggested that the environment directs evolution by permitting only those creatures to survive which happen to be fitted for the particular habitat in which they occur. Whether or not the environment is such as to speed up the rate of mutation, good, bad, and indifferent characters will appear as a result of changes in the chromosomes; and a close functional correlation between an animal and its environment will develop in the course of time due to the failure of the less fitted to live. This would seem to be generally true but it is not the whole story. Recently Prof. D. M. S. Watson, in his address as president of the Section of Zoology of the British Association for the Advancement of Science, said: "I do not know of a single case in which it has been shown that the differences which separate two races of a mammalian species from one another have the slightest adaptive significance." According to Waston, selection by a favorable environment could thus not have produced these racial differences.

What is it then, which has produced species or races of animals? It has long been recognized that "without isolation no species" will be formed. The chromosomes of the fertilized egg lie in pairs, one of each pair derived from the father and the other from the mother. Most mutations occur in only one of each pair of genes in the chromosomes, and in many cases may not express themselves as a structural change in the first generation due to the dominance of the other member of the pair of genes.

If individuals are isolated from the remainder of the species and allowed to inbreed, the characters will appear and become fixed due to the increased chance

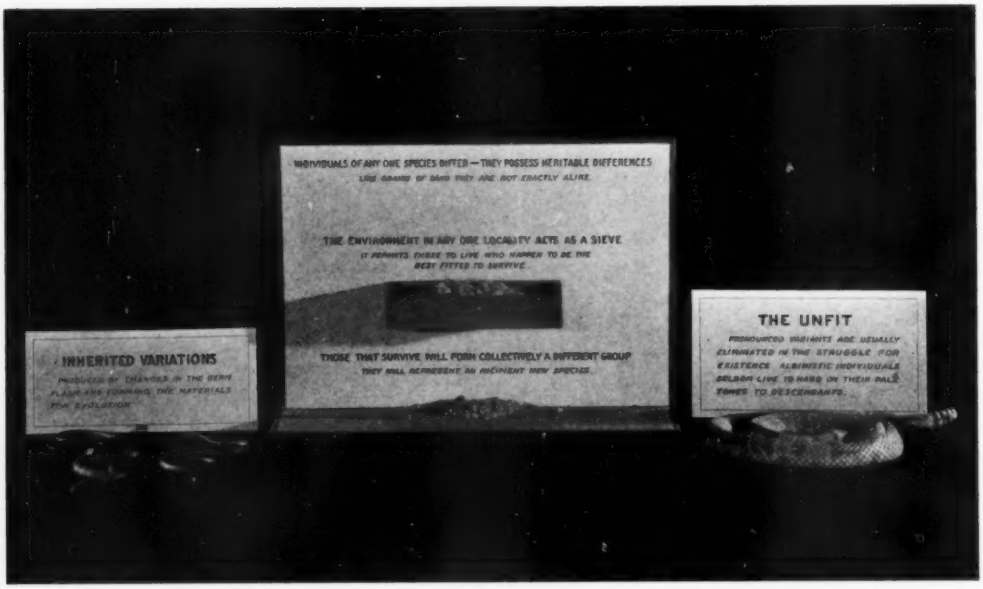
of mating of animals carrying the same factors. Isolation speeds up evolution in the sense that it enables characters to appear. Further, such characters are often not subjected to the sieve of natural selection.

Naturalists have long been familiar with the fact that if wide-ranging species reach islands they split up into distinct forms. For example, the Savannah sparrow has a very extensive breeding range but the individuals which return consistently to Sable Island, off the coast of Nova Scotia, have accumulated enough mutations to be recognized as distinct species, the Ipswich sparrow. Similarly, the meadow mouse, *Microtus*, isolated on Muskeget Island, off the coast of Massachusetts, has evolved into a form differing sufficiently from the mainland species to be called a distinct species. For birds and mammals, geographical isolation is of the greatest importance in the origin of species, for such isolation permits mutations to become fixed.

Where a barrier cuts into the range of a species of bird or mammal, the individuals on either side are usually sufficiently different to be called distinct races. This is not because the environment on either side of the barrier is different, but primarily because the barrier permits isolation. Of course, if the environment is different, the sieves of natural selection on the two sides of the barrier are not the same. In such cases the two races would continue to diverge in evolution until they form distinct species.

EVOLUTION REPEATS ITSELF

The same characters may reappear in different lines of descent. Modern chameleons (right) have redeveloped some of the characters of ancient reptile types. One species has a dorsal crest resembling that of Dimetrodon; another, tusks like those of Triceratops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NATURAL SELECTION

A part of the natural selection exhibit in the Hall of Reptiles at the American Museum. Biological principles are represented in this schematic way in order to bring out more clearly the concepts involved

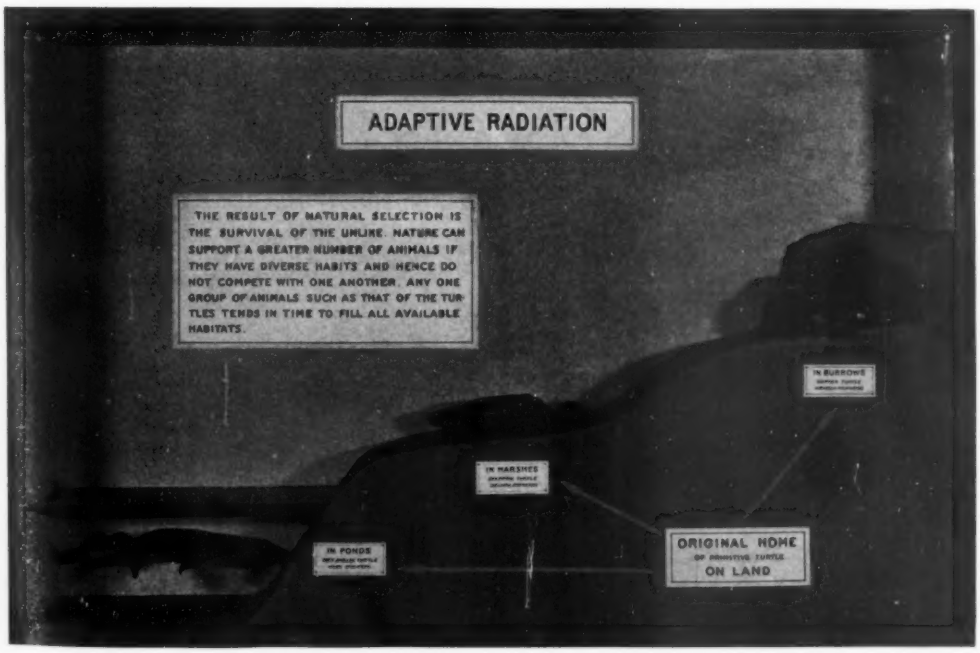
Geographical isolation is the most obvious but by no means the most frequent kind of isolation that occurs in nature. The red-backed and the slimy salamander are two common species of *Plethodon* found near New York. As shown by Shelford, the latter is more sensitive to dry air than the former, and this would explain why the latter is usually found in more moist situations than the former. Further, the former lays its eggs under logs or stones in the woods, while the latter seeks a subterranean retreat to lay its eggs. Lastly, the two species are of very different sizes and hence would not compete for the same food. If, due to a morphological or physiological change, a derived stock is thrown out of competition with the ancestral group and cross-breeding is prevented, the first step in the origin of a new species has been made.

It is not difficult to find species in nature still unborn. For example, a variation of the common Japanese tree frog, *Rhacophorus schlegelii*, has been recently found to lay its eggs in frothy masses on leaves over water instead of in holes in the banks of rice fields. The differences in head form and body size between the two are so slight that the variation is not considered a good species. Since the two forms are apparently completely isolated during the breeding season, they will continue to accumulate mutational differences and increase the divergence. Systematists, for the most part, have not been concerned with the characters which are creating the species. These are usually physiological differences which throw their owners out of competition with their relatives.

One of the least understood features of species formation is that the same characters frequently reappear in not closely related forms. This was explained in the case of insects by assuming that certain species were obnoxious to birds which might prey upon them; and other species, more tasty perhaps, gained protection by

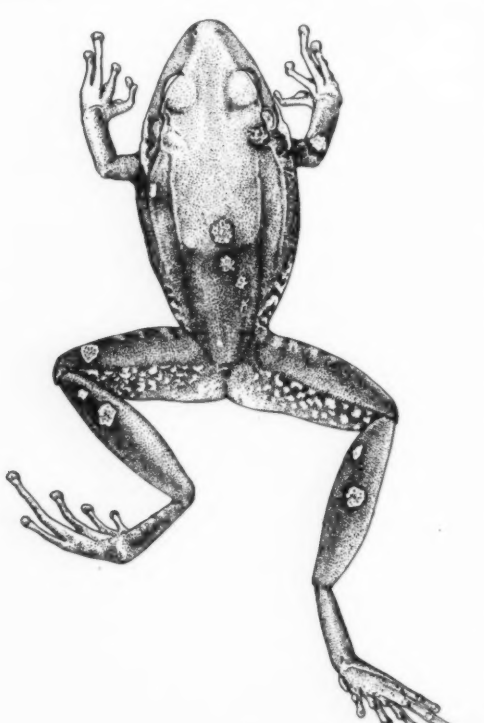
mimicking the former. It has recently been shown by Collinge that, although on rare occasions, birds have been seen to seize butterflies, an examination of over a hundred thousand stomachs has revealed that birds eat few butterflies. Some birds, such as the African wagtails, Dr. J. P. Chapin informs me, do feed extensively upon butterflies, and in this case birds may have played a part in destroying certain kinds of butterflies in preference to others. In general, birds would seem not to have been the selective agent. Mimicry is, moreover, a common phenomenon in both animals and plants. Birds of totally different families in different parts of the world may resemble each other so closely that only a specialist would distinguish between them. The same is equally true of snakes, lizards, and frogs. Such convergence may have been aided by similar kinds of habitats as in the case of certain Old and New World tree-frogs of different families. But when we find the same phenomenon occurring on a large scale in plants, where the seeds of the vetches for example, may closely resemble those of the lentils, as Vavilov has shown, the utility of the character would seem to have played little part in its genesis.

Why, for example, should the chameleons, which are a particularly inoffensive group of slow-moving arboreal lizards, have developed both casques and spines on their heads which closely resemble those of the dinosaur *Triceratops*? We might imagine that the great rhinoceros-like *Triceratops* developed its equipment of head-spikes by gradual selection, and we might even make a calculation as to the thousands of smaller-horned ancestors which must have gone down before the onslaught of the great carnivorous dinosaurs before *Triceratops*, the perfect reptilian citadel, evolved. All this would


ADAPTIVE RADIATION
THE RESULT OF NATURAL SELECTION IS THE SURVIVAL OF THE UNLIKE. NATURE CAN SUPPORT A GREATER NUMBER OF ANIMALS IF THEY HAVE DIVERSE HABITS AND HENCE DO NOT COMPETE WITH ONE ANOTHER. ANY ONE GROUP OF ANIMALS SUCH AS THAT OF THE TURTLES TENDS IN TIME TO FILL ALL AVAILABLE HABITATS.
IN BURROWS
IN MARSHES
IN PONDS
ORIGINAL HOME
ON LAND

THE RESULT OF NATURAL SELECTION
A model in the Hall of Reptiles at the American Museum explaining diagrammatically why species tend to diverge from one another in time

be legitimate speculation but not without taking note that a very similar equipment in the defenseless *Chameleo oweni* apparently came into existence without a long series of intermediate stages acted upon by selection. Further, another chameleon of Africa, *C. cristatus*, has developed a great dorsal crest, a replica in miniature of the crest of the pelycosaur *Dimetrodon* and, like its model, supported by the greatly elongated neural processes of the vertebræ. A similar crest has evolved in an unrelated Central American basilisk, but here confined to the male. Iguanid lizards frequently fight by bluffing their rivals into thinking they are big and dangerous. Whether or not the dorsal crest is useful to *B. basiliscus* during courtship, it is found in only one or two species of the genus and hence probably did not come into existence gradually. Burrowing lizards would not be expected to develop great head or back spines, for such structures would be in their way. Nevertheless, the rhinoceros iguana develops three horns on the snout in both sexes and manages to dig long burrows. Thus, species get along with what heredity gives them and frequently they find some good use for these gifts.

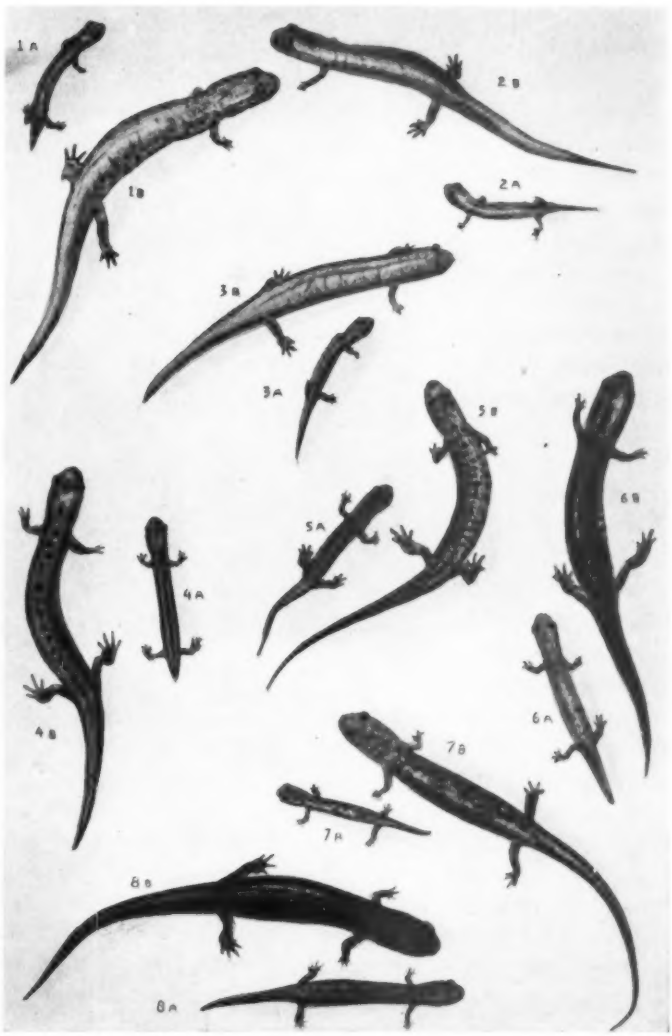


THE ADAPTIVE COLOR CHANGE WHICH HAS NOT SUCCEEDED

In a large series of West Indian tree frogs, *Eleutherodactylus inoptatus*, a few were found with white color spots resembling lichen. Since the frog lives in tall trees and is the color of wood this variation would seem to make the coloration more concealing. However, this color variety has not yet established itself in a large percentage of the group

There are, of course, limitations to evolution imposed by nature; and it is only within these confines that biological forces are allowed to interplay. For example, butterflies frequently swarm near wet rocks on which they alight to drink. They never go to the pools as larger animals would do, for with their light weight they would fall a prey to the surface-tension of the surface film. Nor can butterflies get around this difficulty by growing as large as eagles. Insects, early in their evolution, developed a system of air tubes which carried oxygen directly to their tissues, and the blood concerned itself not with respiration but the transportation of food and waste products. With increase in bulk the problem of sending oxygen long distances in a fine tube becomes very difficult and probably would not be possible at all in the butterflies as large as eagles. Butterflies have proportionately very large wings and they beat them with rapidity. This is because their light weight gives them little momentum and they must devote considerable energy to lifting as well as to pushing themselves forward. A house fly vibrates its wings at a rate of more than nineteen thousand beats a minute, while the slow flap of a crow may be seen by anyone. There are mechanical laws which apply to living as well as to dead material, and species are able to evolve only within these limits.

Increase in size has both advantages and disadvantages. The weight of an animal increases with its volume, but the strength of the limb bones supporting the bulk varies with the cross-section. Hence, the increase in size in land animals conditions a disproportionate growth in width of the limbs until they reach the limit of ungainliness. Frequently the vertebrate animals living in the north or at the higher altitudes of mountains are of larger size than their relatives living in warmer climes. It would seem at first glance that this might be due to the struggle for food in a more rigorous environment, the more powerful individuals having survived. There are, however, subtle advantages of size. The loss of heat from the body of warm-blooded animals would be proportional to the surface. With increase in bulk there is proportionately less surface to the weight and hence greater conservation of heat. As the heat is produced by the combustion of food, a large mammal does not have to eat in proportion to its weight, as much food as a small one. Northern fish are frequently larger than their southern relatives, but this would seem to be due to the fact that cold slows up the processes of differentiation more than those of growth, and consequently fish in cold water would tend to grow longer and attain a larger size than their rapidly maturing relatives of the tropics. Size may be controlled in some species by environment. In cases of warm-blooded animals it would seem more likely that natural selection was favoring those individuals having mutations for increased size. Frequently single



THE MATERIAL FOR NATURAL SELECTION

All these color varieties of the salamander, *Desmognathus fuscus carolinensis*, were taken in a single stream bed near Durbin, West Virginia. Numbers 1–3 have a ground tone of bright yellow or salmon, while Number 7 is silvery. These color differences which appear to be hereditary, are already established at an early age. If a color variety develops a distinctive geographical range, it is usually considered a subspecies

mutations have many effects on an animal's body. The mere fact that a species has a distinctive coloration is no evidence that this played any part in survival. Another expression of this factor, namely size, may have been the character selected.

There are other ways in which size may be correlated with environment. Large animals require more food than small ones. Where food is abundant, as in the case of most species feeding on vegetation, size would seem to be limited merely by mechanical factors of locomotion. On the other hand, insectivorous species would have difficulty in finding food to support a body much larger than a fox. There are, to be sure, a few insectivorous mammals larger than a fox, as for example the ant bear, *Orycteropus*. In these cases, however, the animal is extraordinarily modified for securing large amounts of very abundant kinds of insects. It would be inconceivable for elephants to live on insects, as the source of supply would be inadequate for their needs.

CHROMOSOMES, THE BEARERS OF HEREDITARY CHARACTERS

These dark stained bodies which form the most conspicuous part of the nucleus of every animal and plant cell, carry the hereditary factors. (From a study by Foot and Strobell)

It has frequently been noted, especially in fish, amphibians and reptiles, that one species has been derived from another chiefly by arrested development. Something inside the animal prevents it from completing the development found in related forms. Still in addition to factors slowing up growth there may be others producing distinctive changes not found in the young of ancestral species. For instance, *Siren* is a large salamander which has gills, larval jaws, and rudimentary limbs. It might be considered a larva which has failed to differentiate beyond a very early stage found in the life of other salamanders. But *Siren* has certain peculiarities of its own, for example, the large Jacobson's organs with which it tests its food. New species are produced not by the addition of stages to more primitive species but by a modification of the processes of development of the former. This modification may mean a loss of growth, an extension of the growth period, but more usually it is the matter of a differential growth of certain parts. Such modifications are produced by genetic factors. Some may be adaptive in the sense that they permit the animal to meet new conditions of life, but others are merely arrested growth stages without such a significance.

When the differences between species is principally a matter of arrested development, it would seem possible by endocrine treatment to return the derived form to its ancestral state. The giant salamander of eastern United States, for example, may be considered a species which so far as many of its structures are concerned, ceased to differentiate beyond the early stages of metamorphosis. If *Cryptobranchus* could be induced to metamorphose, it would change first into *Megalobatrachus*, the genus including the giant salamanders of China and Japan,

and then into a Hynobiid salamander. The distinctions between the genera *Cryptobranchus* and *Megalobatrachus*, and between the families Cryptobranchidæ and Hynobiidæ are essentially metamorphic differences. In the American Museum laboratories, as E. J. Farris and I showed, very young *Cryptobranchus* would metamorphose their skin into that of a typical land salamander when treated with thyroid extracts. There seemed to be some physiological block preventing this metamorphic change to include other tissues. The nature of this block has not yet been determined.

The glands of internal secretion have an important control over the processes of growth and differentiation. The growth of the skeleton, especially the long bones, is hastened by a secretion from the anterior lobe of the pituitary gland at the base of the brain. Giant rats and salamanders have been produced by treatment with pituitary substance. Still it has not yet been shown that the only difference between a giant and a dwarf species in nature is that the former has an hypertrophied pituitary gland. Whether or not this is demonstrated by future investigation, it must be remembered that the size of the gland in any species of animal is determined originally by developmental peculiarities produced by the action of the genes.

It is sometimes stated that all characters of animals must have some use, although our lack of knowledge concerning the habits of most species prevents us from defining these uses. If attention is focused on a particular set of characters such, for example, as the secondary sex characters, all possible uses of these structures may be worked out. Recently in our laboratory we discovered that the male plethodontid salamanders, the common species of the New York region, were equipped with special glands over the greater part of the body of the male, and these apparently served to hold the female's attention during courtship.

ISOLATION IN SPECIES FORMATION

Mutations produce physiological differences which determine the particular habitat in which each species can best live. These western toads have well marked habitat preferences. Isolation is the first step in the origin of a new species. (From a model in the Reptile Hall of the American Museum)

Further, some male plethodontid salamanders develop sharply pointed teeth in both jaws. A detailed study of many breeding pairs in the laboratory has failed to disclose the use of these elongated teeth. Mutations which afford greater efficiency in the process of reproduction would be saved by the selection process of nature and become part of the hereditary endowment of each sex. There is some reason to believe that the hedonic glands of these salamanders were evolved from the cheek glands of male newts which also play a rôle in courtship. However, other mutations may occur on the sex-determining chromosomes and be carried along by heredity because they are not detrimental to the species. Such a fact would explain the peculiar teeth of many plethodontids. Another distinctive feature of secondary sex characters is that characters found only in the male of one species may appear in both sexes in another. This is a common phenomenon in birds, lizards, frogs, and salamanders, and is one of the reasons for believing that many secondary sex characters do not have specific functions. An explanation for this shift is to be found in changes in the chromosomes, one of several possibilities producing the same result.

In brief, the study of species origin is today no longer a matter of speculation. By laboratory methods one may produce new types of animals and plants at will. The conditions producing new species in nature will, of course, vary with the type of environment and kind of species considered. The naturalist of the future will no longer have to guess as to the effect of the environment. By carefully planned experiments he will be able to demonstrate the part environment has played in the evolution of particular species. Evolution is today an experimental science.

WHICH IS WHICH?

The legless lizard, *Amphisbaena*, resembles the earth worm closely. Both burrow in the ground and have assumed a form efficient for locomotion underground. The lizard, lower figure, and the earth worm, represent a case of convergent evolution

EXTINCT ALASKAN SUPER-BISON WITH 53-INCH SPREAD OF HORNS (BELOW) COMPARED WITH AN UNUSUALLY LARGE AMERICAN BISON (ABOVE)

ALASKA'S FROZEN FAUNA

Alaska College and the American Museum of Natural History Join Forces for the Preservation and Study of Remains of the Mammals of the Frozen Tundra Brought to Light in Extensive Modern Gold Mining Operations

By CHILDS FRICK

Research Associate in Palæontology, American Museum

EIGHTY years before wondering Klondike miners drove pick or shovel into the skull of mammoth or super-bison, the discoverer of Kotzebue Sound had recorded the sight of elephant bones lying beneath an iced Alaskan cliff:

. . . At this news, we all went, provided with shovels and crows, to examine this phenomenon more closely, and soon arrived at a place where the bank rises almost perpendicularly out of the sea, to the height of a hundred feet; and then runs off, rising still higher. We saw masses of the purest ice, of the height of a hundred feet, which are under a cover of moss and grass. . . . An indisputable proof that what we saw was real ice, is the quantity of mammoth's teeth and bones, which were exposed to view by the melting, and among which I myself found a very fine tooth. We could not assign any reason for a strong smell, like that of burnt horn, which we perceived in this place. The covering of these mountains, on which the most luxuriant grass grows to a certain height, is only half a foot thick, and consists of a mixture of clay, sand, and earth.[1]*

Fired by similar accounts and tales of miners feeding their dogs on buried meat, the National and American Museums on four occasions have sent their representatives to Alaska in the hope of obtaining the frozen carcass of woolly mammoth or other ancient game such as have been found in Siberia.[2]

. . . Of all the fossil animals that have been ever discovered, the most remarkable is the entire carcass of a mammoth, with its flesh, skin, and hair still fresh and well preserved, which in the year 1803 fell from the frozen cliff of a peninsula in Siberia, near the mouth of the Lena.[3] Nearly five years elapsed between the period when this carcass was first observed by a Tungusian in the thawing cliff, in 1799, and the moment when it became entirely disengaged, and fell. . . . Here it lay two more years, till [a] great part of the flesh was devoured by wolves and bears; the skeleton was then collected by Mr. Adams and sent to Petersburg. Many of the ligaments were perfect, and also the head, with its integuments, weighing four hundred and fourteen pounds without the tusks, whose weight together was three hundred and sixty pounds. [A] great

*For footnote references, see Bibliography on Page 80

part of the skin of the body was preserved, and was covered with reddish wool and black hairs; about thirty-six pounds of hair were collected from the sand, into which it had been trampled by the bears. . . . One thing . . . is certain as to this mammoth, viz., that whether it was imbedded in a matrix of pure ice or of frozen earth, it must have been rapidly and totally enveloped in that matrix before its flesh had undergone decay, and that whatever may have been the climate of the coast of Siberia in antecedent periods, not only was it intensely cold within a few days after the mammoth perished, but it has also continued cold from that time to the present hour.[4]

In the vicinity of the same Kotzebue Sound the American Museum's expedition of 1907 actually obtained remains of a mammoth with parts of the flesh and long black hair attached. But previous to the stripping operations of the modern gold mining industry, Alaska offered little opportunity to fossil hunters who journeyed for over four thousand miles to be confronted with endless stretches of tundra, brush, and forest-covered plateaus and ridges, and who had to be content with the occasional yield of tumbled bluff or eroded river bank. The joint attempt of Alaska College and the American Museum of Natural History the present summer, to take advantage of the unusual opportunity afforded by the present vast stripping operations of the mining industry, was the outcome of correspondence between President Charles E. Bunnell of Alaska College, Mr. Neil W. Rice of the U. S. Smelting and Mining Company, and our museum. The field work was in charge of Mr. Peter Kaisen, for more than thirty years a member of the American Museum's department of vertebrate palæontology, who sailed from Seattle in late May and a week later entrained at Seward for the 475 mile journey to the College of Alaska at Fairbanks on the Tanana. Thanks to the hearty and friendly coöperation of Messrs. O. J.

HYDRAULIC MINING
A powerful stream of water operating against a cliff removes the frozen muck foot by foot

A FROZEN CLIFF
What appears to be a rocky wall in this photograph, is in reality frozen muck interspersed with ice

Egelston and R. B. Erling, and the staff of the Fairbanks Exploration Company, the joint Museum and College party succeeded in harvesting during the four summer months some twenty-eight large cases of skulls, jaws, and bones — rare and important evidence on the prehistory of Alaska which otherwise would have been lost to science. The great percentage of this material, interestingly enough, came from three restricted areas, "bone pits," scattered between several widely separated operations of the Company, the remainder of the worked areas being, for the purposes of the bone hunter, nearly barren.

Placer gold, a derivative of anciently eroded quartz veins, occurs in the frozen gravels of former stream channels now buried at variable depth beneath later superincumbent and similarly frozen deposits. These latter over large areas consist of fine silts that represent the drained floors of former lakes, and here and there contain the bones of extinct animals. Now these residual silts, sometimes exceeding two hundred feet in thickness, are entirely masked from view beneath tundra, brush, and forest-grown flats save where exposed in cross section in the high banks of the deeper cuts of the present stream courses. To obtain the gold, the operators, by means of jets of water impinged from hydraulic giants, first remove the tundra and forest growth of the natural surface, and then the underlying and deeply frozen muck foot by foot as it thaws under the summer sun, from bank inward and from top downward. It is this wholesale stripping which affords such unusual opportunity for the location and securing of occasionally imbedded remains of the ancient fauna. Thus it is that the modern placer industry offers a realization of the bone digger's fondest dream—the magic waving aside of hills

GOLD MINING BY SUCTION DREDGE
A monster gold-mining dredge operating in an Alaskan valley

and uncovering of deep-laid strata over which, as along some beach at ebb tide, he may walk and garner a host of until now hidden forms. When once the higher lying deposits are reduced to the general drainage level, or when the gold-bearing gravels happen to lie but a few feet beneath the valley floor, the remaining residue is removed by impounded suction-dredges, without further preparation than the ever necessary thawing out of the solidly frozen ground. The fossil evidence of these lowest and therefore oldest layers of the ancient lake bottoms is unfortunately destroyed unseen as it is ground up within the maws of the dredges.

The percentage of the remains of animals preserved through natural burial is usually small and the opportunity of locating such burials, save in widely disintegrating hill land, such as in our western Bad Lands, is very slight. Success, no matter how strenuous the use of pick and shovel or of the horse- or tractor-drawn scoop, must always in a high degree be dependent on good fortune. An unusual example of such toil and unexpected reward was our six-weeks' investigation the past summer of a grassed-over hill land in northwestern Nebraska, where the outcrops of certain fossiliferous layers now and again have been hunted for the mineralized bones of the Sheridan fauna. (See table on p. 79.) Here our assistant, Mr. Falkenbach, had the good fortune, on excavating a 90×40 area to twenty-foot depth in search of further evidence as to the peculiar stilt-legged horse, to happen upon a beautifully preserved skull, jaws, and partial skeleton of the huge and rare so called Arctotherine "bear" (*H. simus nebrascensis* n. subsp.).

The vast operations in Alaska slush aside acres upon acres, while our chug-

CHARLES E. BUNNELL
President of Alaska College. The two mammoth tusks were procured by the American Museum and College of Alaska 1929 Expedition. They measure 11 feet 8 inches and 10 feet 10 inches in length

SKULLS OF MAMMOTH, SUPER-BISON, AND LION
The leader of the expedition, Peter Kaisen, is shown here with some of the important finds

chugging Nebraskan tractor scoops a few yards square. At one place the newly washed surface of former Alaskan accumulations exposes the eleven and one-half foot tusk of a mammoth and limb bone of a horse. Near by, at what was recently ten feet beneath a thickly tundra brush-grown plateau, stand undisturbed the broken stumps of an ancient forest. At another operation there is found the hind limb of a moose with hoof and some of the hair attached, and the skulls of a wolverine and badger, and again the widespread horns of an enormous bovine. And near the mouth of a gulch ten miles to the north in similar frozen muck, together with fine specimens of the same huge bison, at still deeper depth, to the general amazement of all, there appears the skull of a very African-like lion!

The great accumulation of fine and unstratified silts that, as already noted, line, over large areas, the present water courses of the interior plateau of western Alaska, indicate the former presence of extensive lakes and morasses and the endurance of long periods of quiescence. This northern area, strangely enough, is reported to have been largely unglaciated. The cold of the winters, however, has long been intense, and now the deepest deposits of the valleys are frozen to bed-rock. The freezing, which probably was effected earlier than the general elevation of the deposits, and the ensuing cutting of the present channels may have taken place subsequent to the engulfing of many of the included mammalian remains. Early reports of the occurrence of interstratified layers of ground ice and muck have

FOSSIL BEDS AT HAY SPRINGS, NEBRASKA
This photograph was taken before the work of stripping began. The picture at the right is of the same fossil beds

been shown at least in instances to be due to the formation of winter ice along seepage planes and in crevasses occasioned by the seasonal down-working and slipping of plateau edges and the masking and burial of this ice beneath falling vegetation.[5]

At various points, . . . beds of silt having the same appearance as those now being formed by the river have an altitude several hundred feet or more above the present stream, and are sometimes as much as 200 or 300 feet in thickness. . . . It has previously been suggested that the higher silts of the Yukon Flats were probably deposited in the bottom of a shallow lake, while the more recent ones were formed under lacustrine conditions in time of flood, and the step from one to the other condition is very slight. The elevated beds of pure silt . . . were formed at a period when lacustrine conditions prevailed for a comparatively long time; for they are often many feet thick, without any layers of vegetable matter or of coarse detritus . . . [Along the Yukon and in the vicinity of] the Five Finger Rapids, there is often a layer of river pebbles and sand, horizontally stratified, topping the silt beds and resting unconformably on them where they have been plicated. This layer is never more than a few feet thick, and is often entirely wanting. On top . . . is everywhere seen a thin layer of white, gritty volcanic ash, which ordinarily conforms to all the little irregularities in the surface . . . and is immediately overlain by several inches of vegetable loam . . . It may be said in general . . . that

A BANK OF FROZEN ALASKAN MUCK
Partly worn away by the hydraulic stripping operations

FOSSIL BEDS AT HAY SPRINGS, NEBRASKA
After the tedious work of stripping had been largely done. The picture at the left shows these beds before the work began

the accumulation of the silts began in shallow lakes and sluggish rivers on the emergence of the land from the sea after the maximum extension of the cordilleran glacier, and has continued on a progressively smaller scale up to the present day. . . . In the Upper Yukon region the silts seem to have been largely derived from material ground out of the rocks by glacial action . . . "[6]

Horses, while extinct in America before the coming of Columbus, in Pleistocene time ranged, together with species of the mammoth and mastodon, across the northern continents and extended southward into Florida and into Italy. (See table of surviving and extinct species on page 79). In the northern latitudes the mastodon seems to have been relatively rare — perhaps in habit he was largely solitary. Unlike the mammoth, he has left no immediate kin, his tusks were relatively short and straight, and his great, grinding molars "saw-toothed." The size and number of the mammoth herds that once thrived in the northland are beyond belief. As early as the time of Catherine the Great the recovery of tusks of the extinct mammoth had become an industry. Fifteen hundred pairs are recorded in a single year. The word "mammoth" itself is said to be of Tartar origin meaning "animal of the earth."

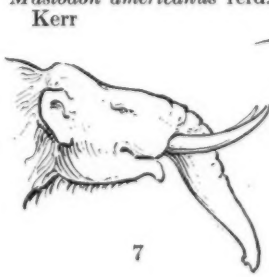
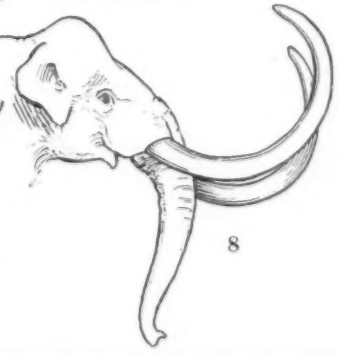
MAMMOTH TUSK AND HORSE LIMB-BONE
Lying as they were uncovered by the hydraulic stripping operations

The tusks are very long and greatly curved, the huge grinders lamelliform and the ears small—grinders and ears both being suggestive of the Indian elephant of today. While portions of hair and flesh of the Alaskan mammoth have been encountered, no complete or nearly complete carcass has ever been found. Our joint expedition of the past season secured, besides two large tusks, etc., limb bones, teeth, and three skulls. One of these skulls is practically complete, the slenderness of the single remaining tusk suggesting a female. A second skull is unique in indicating the long and easy life that these animals must at times have enjoyed—the individual specimen being of extremely old age, and without teeth or alveoli, the last great pair of grinders having been worn through and shed years past!

The ubiquitous skulls of the super-bison of Alaska indicate colossal herds and an ample supply of food. One cannot but wonder whether sections of these herds may have occasionally perished by extreme cold like the fifty wild yak seen by two missionaries in 1846 frozen in ice at the headwaters of the Yangtze-kiang River. It is inferred that the longest and widest spread horns of the thirty newly secured crania belonged to bulls, and the more moderate remaining specimens to cows. The horns of the super-bison of Alaska (*B. crassicornis* Rich.) greatly exceed in length those of the recent Plains species (*B. bison*) and of the relatively less massive-shouldered "Wisent" of Europe (*B. bonasus*). (The latter must be distinguished from the great wild ox, Aurochs (*B. primigenius*), which was apparently contemporaneous with *B. priscus* in the forests of Europe in Cæsar's time.) The more moderate sized of the Alaskan heads are approximated by specimens of the extinct European and Siberian bison. It is worthy of note that an almost equivalent range in spread of horn to that existing between the largest of the Alaskan forms and the recent bison of the Plains, occurs in the African buffalo (*Syncerus caffer*) as exemplified in comparison of its great southern and eastern with its smaller northwestern species. Horns somewhat similar to those of the larger Alaskan bulls are suggested by certain fragmentary specimens from the western plains deposits (the basis of a number of named species) — the greatest of these is the extraordinary Kansas type, *B. regius* Hay.

Of the six larger flesh-eating forms of Post-Oligocene time two, *Hyaenarctos* and *Amphicyon*, became extinct before the Pleistocene and today only two survive—the lion and the big brown bear. The strange and huge Arctotherine bear of Alaskan and more southern range, and the magnificent saber-toothed tiger (*Smilodon*)—as yet unrecognized in the northland—both became extinct previous to recent time. The lion and true bear have survived on opposite sides of the earth, the one would seem to have followed fat game herds to equatorial regions, while the other abided by the salmon streams. The big brown bear, differing widely from the Arctotherine "bear," much resembles the huge European cave bear (*U. spaelus*). The great American lion now for the first time shown to have been present in the Pleistocene of Alaska was already known from Mississippi and the tar-seeps of Rancho-la-Brea. Though in the ancient northland the tiger rather than the lion would be expected, on the basis of the former's present much more northern range, the skulls of the Alaskan lion (*Felis atrox alaskensis* n. sp.) and of the cave lion of Europe (*Felis spaelea*) are distinctly leonine rather than tigrine. Perhaps the shaggy mane of the African lion, like the woolly forequarters of the bison, are remnants of a former frigid habitat.

Alaska, the last stand of the giant

SURVIVING AND EXTINCT PLEISTOCENE MAMMALS	EXTINCT FORMS	
	Pre-tundra Fauna of Alaska-Yukon	Sheridan Fauna of Nebraska
Carnivora		
ARCTOTHERE Black and Grizzly Bears (*Ursus* and *Danis*)	*Arctodus yukonensis* Lambe[1]	*A. simus nebrascensis*, n. subsp.
	1	
DIRE WOLF	*Aenocyon dirus alaskensis*, n. subsp.	*A. dirus nebrascensis*, n. subsp.
Wolf and Coyote (*Canis*)		
Fox (*Vulpes* and *Urocyon*)		
Badger (*Taxidea*)		
Skunk (*Mephitis* and *Spilogale*)		
Weasels and Otters (*Mustela, Lutra, Lutreola* and *Putorius*)		
Wolverine (*Gulo*)		
SABER-TOOTHED TIGER	3	2
LION	*Felis atrox alaskensis*, n. subsp.[3]	*Smilodon nebrascensis* Matthew[2]
Bobcat		
Edentata		
GROUND SLOTHS		*Mylodon nebrascensis* (Brown) *Megalonyx* sp.
Artiodactyla		
CAMEL	4	
TANUPOLAMA	*Camelops* race Gidley[4]	*C. kansanus* Leidy *Tanupolama americana* (Wortman)
Antelope		*Antilocapra* sp.
CAPROMERYX		*Capromeryx furcifer* Matthew
Deer (*Odocoileus*)		
Bison	*Bison crassicornis* Rich.[5]	*B. ferox* Marsh
Peccary		*Platygonus* sp.
Caribou (*Rangifer*)		
Moose (*Alces*)		
Big Horn Sheep (*Ovis*)		
Rocky Mountain Goat (*Oreamnos*)		
Musk-ox (*Ovibus*)		
SYMBOS	5	6
	Symbos tyrelli Osgood, and *Bootherium sargenti* Gidley	
Perissodactyla		
HORSE	*Equus alaskae* Hay[6]	*E. excelsus* Leidy *E. calobatus nebrascensis*, n. subsp.
Proboscidea		
ELEPHANT	*Mammonteus* (*E.*) *primigenius* (Blum.)[8]	*Archidiskodon* (*E.*) *imperator* Leidy
MASTODON	*Mastodon americanus* refd.[7] Kerr	*M. americanus*
Shrews, etc. (*Insectivora*) various species		
Bats (*Chiroptera*) various species		
Rodents (*Rodentia*) various species		
	 7	 8

PRELIMINARY LIST

Surviving Pleistocene and (capitalized in first column) *extinct* Pleistocene mammals of Alaska-Yukon and Nebraska areas, with scaled heads of certain of the extinct genera

moose and of the big brown bear, was once the host to other giants now long since passed on. Certain owners of these frozen bones, the objects of our search, perhaps in measure contemporaneous with the reindeer fauna and cave man of southern Europe, may at times have afforded sport to Alaskans yet unknown. Arrowheads, one reported to have come from bedrock twenty feet below the recent surface, suggest at least, as President Burnell writes, the contemporaneous presence of some early hunter. The ground once broken, what fields Alaska opens to Quaternary research—the buried bones and forests of mammalian and plant denizens of prehistoric time, whose minutest details frozen carcasses and vegetation yet may reveal; and the thick enveloping mucks and sands in far-flung strands, superficial of today and deep laid of ages gone, that yet, with interstratified clays in possible reconstructed sequence from earliest glacial era, may correlate and index the passage of mammals, plants, and time.

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THE LION OF INDIA

An Account of the Vernay-Faunthorpe Expedition to India, December, 1928, to March, 1929

By ARTHUR S. VERNAY

IT is not remarkable, that in the minds of people of today, the lion is almost invariably associated with Africa.

The Asiatic lion, never numerous, is gradually becoming extinct. Dr. W. T. Blanford in *The Fauna of British India*, 1888–91, stated that it was common in Mesopotamia and part of southwestern Persia, but the information I received while in Syria, Mesopotamia, and Persia, was that the lion is extinct all through these countries. Possibly a few may still be found on the borders of the Tigris and the impenetrable thickets and reeded swamps bordering on the Euphrates, on the Zagros Mountains, and the thickly forested ranges near Shiraz, but this is unlikely since none have been recorded for many years.

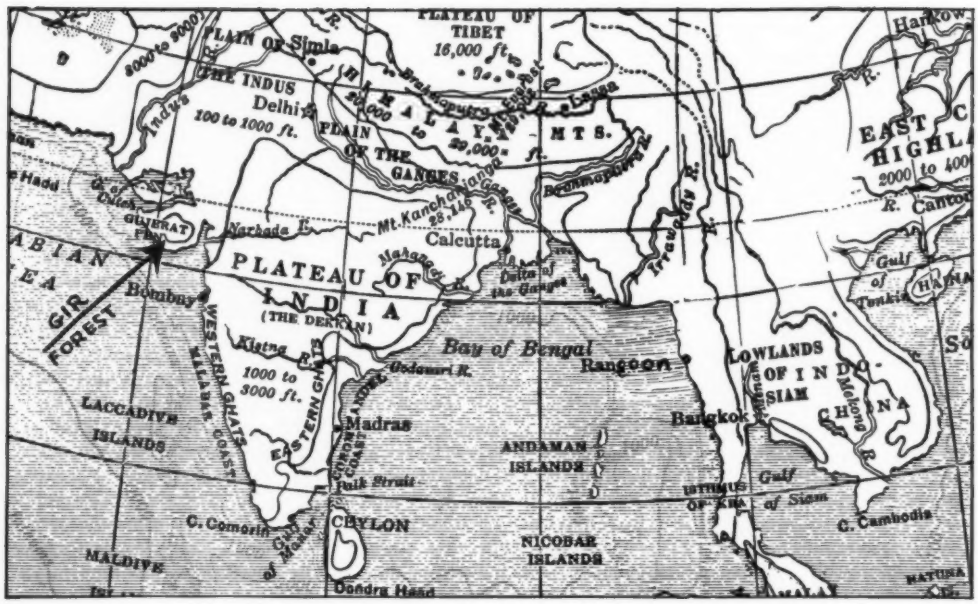
I believe, therefore, that we can assume that the lion in this part of the world is almost, if not entirely, extinct, and it is only in the Province of Kathiawar, a small peninsula northwest of Bombay, that the true Asiatic lion can still be found. Even there it exists only in the Gir Forest, an area of four hundred square miles in the State of Junagadh.

Junagadh is the chief state of the Province of Kathiawar, and is under the rule of His Highness Sir Mahabat Khan Nawab, Nawab being the Mohammedan equivalent of Maharajah in Hindoo.

It is only a question of time before the lion will disappear even from this district, although at present it is closely protected. The number, which is roughly estimated at 200, is not increasing. The inevitable diminution of the forest, in spite of the restrictions against cutting, and the possibility of disease owing to the confined area, mean ultimate extermination.

The Indian lion is an interesting subject. In the first place, even in India there are few sportsmen who have ever seen one, still fewer who have ever had the opportunity of shooting one, and mounted specimens are not to be found either in England or America. The American Museum of Natural History has one skin of an animal which was shot several years ago by Lord Lamington, but this is not fit for mounting. In the Prince of Wales Museum in Bombay there is an immature male, not in any way a representative specimen, and the Bombay Natural History Society hopes that the Nawab of Junagadh will give the Society permission to obtain one, particularly as it is for an Indian Museum. The two mentioned comprised all the museum specimens up to a few months ago, when we obtained a pair for the American Museum.

They are royal game, jealously guarded, and quite rightly so. If one speaks of the Indian lion to a sportsman in India, one generally receives the reply, "Oh, you mean the maneless lion." Another remark is, "There are no true Indian lions. Those that are here were imported from Africa 30 to 40 years ago." This is quite a reasonable supposition, as a small number were imported into Gwalior about that time, but after a few years they became a pest, killing not only the cattle of the natives, but also the natives themselves, so the African lions were all eventually shot out. Also, the tigers of Gwalior are famous, and as tigers will not permit lions to remain in their terri-



SHOWING THE LOCATION OF THE GIR FOREST

In the limited district marked by the Gir Forest, which is situated in Kathiawar, are to be found the only lions that are native to India. Formerly their range was much wider, but today they are very much restricted and it is highly probable that their total extinction is a matter of comparatively little time

tory, they must have helped to kill off the lions. But more of this later. In the meanwhile, the true Asiatic lion lived and still lives in the Gir Forest, which is about three hundred miles from Gwalior and an entirely different type of jungle.

The lions used in the arenas of Rome were African lions. The Biblical lion, the lion of Daniel, it is believed was a true Asiatic lion. We will not speak of the Macedonian lion; let us begin by admitting the existence of the lion at one time in Syria, trace it down the Tigris and Euphrates Rivers through Persia, where a few may possibly exist today, to the oak-clad ranges near Shiraz.

Unquestionably, in ancient times lions were numerous throughout Syria, Mesopotamia, and Persia. The Syrians frequently used the lion motif as a frieze decoration, and at Persepolis, thirty miles northeast of Shiraz, where the magnificent ruins of the palace of Darius the Great may still be seen, the lion as a decorative architectural motif was constantly used. In the embrasures of some of the great doors of Persepolis the winged lions were magnificently carved. The feathers of their great wings are almost as sharp today as when they were cut more than two thousand years ago.

We have traced the lion to Persia, now let us follow its course through to India and disprove the theory that the Indian lion is an African lion imported either by the Maharajah of Gwalior or by some previous eastern potentate.

We have not far to go in order to get into India where, as I have said, the true Asiatic lion exists at the present time. From Shiraz, keeping due east to Kerman across the Shurgaz Desert to the border of Persia and Baluchistan, southeast, a matter of twenty-four hours by train, we find ourselves on the border of the country where the Indian lion lives today. I was told, while in Duzdab, the frontier town on the Baluch-Persian border, that

the lion existed in Afghanistan seventy-five years ago. This is mere hearsay, but it sounds quite reasonable. In order to make the situation a little clearer let us find Karachi on the map, a familiar name. The State of Junagadh is within a day of Karachi.

In earlier times, the lion, as records show, was comparatively common in India as far down as the Central Provinces. At the beginning of the Nineteenth Century it was found in the northwest of the Central Provinces, and Doctor Spry, in his *Modern India*, states that, when he was at Saugay in the Central Provinces, there was brought to him the skin of a full-grown male lion which had been killed by natives. This was in 1837, and from 1837 to 1864, there appear frequent references to lions in these Provinces, but at no time is it recorded that lions were common, although possibly they were there in considerable numbers at one time. In the old sporting books there is mention of a lioness in 1834. We hear of them again in Saugay from 1857 to 1864. The native shikaris spoke of having seen a tiger without stripes. After 1864 it appears the lions were driven out, possibly because the jungle became unsuitable. Again, it may be that the extermination of the lion throughout this part of India is due to the tiger. This is Mr. A. Dunbar Brander's opinion and he is one of the great authorities on Indian game.

It is a well-known fact that in combat the tiger invariably defeats the lion. So far as I can ascertain, there is only one instance on record of a lion's beating a tiger, and this happened in a circus where they were confined in adjoining cages. The animals broke through the partition and engaged in mortal combat, the lion being the victor; but this cannot be used

A TYPICAL VIEW IN THE GIR FOREST

Though taken in India, this view is also typical of those districts of Tanganyika Territory and Kenya Colony, in Africa, where lions abound. Thus it is obvious that the lions still to be found in India and those of Africa inhabit similar country

as a criterion. The caged lion or tiger is a poor creature in comparison to these animals in their natural habitat. In this particular instance, the tiger might not have been in good condition, and the lion freshly brought in.

The tiger is not only more cunning than the lion, but is also a heavier animal. Sir John Hewitt, late Governor of the United Provinces, who is a great expert on tigers, says that a good specimen measuring around ten feet will average from 500 to 510 pounds.

While I was hunting last year with the Heir Apparent of Bikenir, who had just returned from shooting in Gwalior, he informed me that he had shot a tiger measuring 10 feet 3 inches, and weighing 620 pounds. The animal was taken to a small station where there was a weighing machine, and the Maharajah Kumar himself witnessed the weighing, and checked the weight; but there is this to be said, that the weighing occurred several hours after the animal had been killed. In any event this is quite abnormal, and 450 to 500 pounds is the usual weight of big tigers.

I have never had the opportunity to weigh lions in Africa, and the old lion we shot weighed approximately 410 pounds, as near as we could weigh it by the scales we had in camp. Mr. James L. Clark, who is very well informed on the lion of Africa, told me that a big African lion weighs about 450 pounds and averages in length about 9 feet to 9 feet 3 inches.

We can safely say that a big tiger measuring roughly 9 feet 6 inches would weigh about 475 pounds; a ten-foot tiger is not uncommon, consequently there would be greater length, greater weight in favor of the tiger, and greater cunning as compared with the lion. The fact that the tiger does not exist in the Province of Kathiwar, consequently may be one of the reasons why the lion's final stronghold is in the State of Junagadh.

From my observation, there is apparently no important difference between the Indian and the African lion. It is a curious fact that the Indian lion for some reason appears to carry less mane than the African lion, although in captivity the Indian species develops a good mane. It is generally supposed that this is because of the great quantity of acacia and thorn bush which is found in the Gir. This does not appear to me to be correct, as the country of the Gir, although thorny, is by no means as thorny as many parts of Africa, especially Angola where, on the banks of the Cunene River in dense thorn country far worse than the Gir, I shot a lion with an enormous mane. Mr. Dunbar Brander thinks the cause may be interbreeding, owing to the limited area. The black-maned lion has never been seen in India, the manes there being tawny, running to a very light yellow.

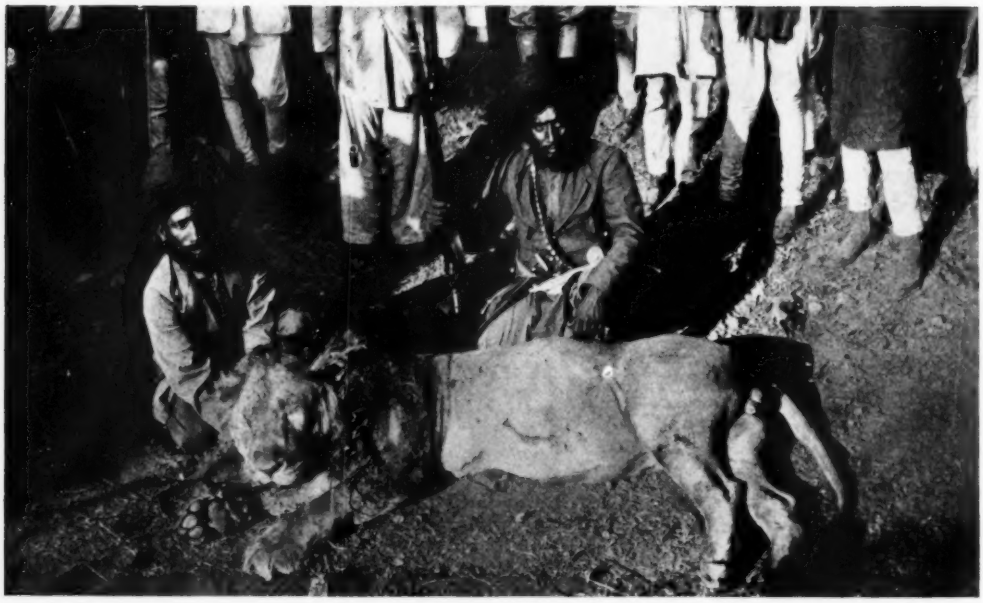
The male African lion has what is called a thorn in the end of his tail—a sharp bony point, of conical shape, about $\frac{3}{16}$ inch at the base and about the same length; consequently one of the first things we did was to find out if the male Indian lion had the same kind of thorn. It was there. Why this thorn should exist in the male is an interesting problem. It may be used for scratching purposes, as the lion frequently switches his tail over his back. Again, if the lion lashed his tail, this small point could inflict a certain amount of damage.

In discussing the Vernay-Faunthorpe collection, Prof. Henry Fairfield Osborn on several occasions emphasized the fact that one of the most important desiderata was a good specimen of the Indian lion. Some of the other groups, such as the water buffalo, the elephant, the tsine in Burma, and the elusive wild dog in India, presented difficulties, but here was one the obtaining of which seemed almost unsurmountable.

PANCHAN, THE EXPEDITION SKINNER
This expert has followed Mr. Vernay's expeditions all about India and probably has skinned more different species of Indian animals than any other man. He holds the skull of a lion in his nand

The late Colonel Faunthorpe was most persistent and indefatigable in arriving at his objective, which was to obtain from His Highness the Nawab of Junagahd permission to shoot one specimen. We were asking a great favor. For three years Colonel Faunthorpe continued his efforts. Every avenue of approach was tried without avail and it seemed almost hopeless until we obtained the help of Major F. B. N. Tinley of the 20th Deccan Horse, then Chief Secretary in Junagadh. The first discussion with Major Tinley was in London. He said that on his return to India he would find out what could be done. Eventually, through his assistance, the Nawab gave us permission to shoot a male and female. There was joy in the land. We anticipated this *shikar* with the keenest pleasure. It was the culminating point in the formation of our collection, with one exception, and that is the small one-horned rhinoceros, which we hope to obtain in the course of time. Already two expeditions have been made for it. However, that is another story.

Colonel Faunthorpe and I many times discussed our plans. Every preparation was made to insure success, and the Nawab gave orders that everything possible should be done in order that we might secure these specimens for the American Museum of Natural History. The time chosen was February, 1929, and Colonel Faunthorpe and I journeyed from Bombay to Rajkot, on the border of Junagadh. There motors met us and we were taken to the capital, Junagadh, and later on in the day proceeded to camp at a place called Sasan, which is on the fringe of the Gir Forest. Major Tinley accompanied us as our host, and a better one we could not have wished for. We settled down in a camp which had been built for the Viceroy, Lord Irwin, who had planned to shoot there last year, but owing to his having to return to Delhi, his shoot was abandoned. We therefore had the pleasure of using this luxurious camp.



A FINE SPECIMEN OF INDIAN LION
So similar to the lions of Africa was this animal that, had he been found in Tanganyika Territory, no one would have questioned him as a native African beast

During the first few days luck was against us; no news came in. We hunted without avail. We beat here and there, but it was useless beating unless we had some definite news that the lion had been tracked and the spot where he was taking his daily siesta located. We were somewhat worried, as we had been told we might expect to get one the first day or two. On the fifth day news came that lions had been seen in a certain part of the country. We beat for them, sat up for them, but nothing happened.

But I am getting ahead of my story; we must speak of the country. It is extremely interesting and reminds one very much of certain parts of Africa, especially Angola. The greater part of the jungle is covered with stunted dwarf teak, bamboo, and thorny barbul (*Acacia Arabica*), and a beautiful tree, Sterculia, called by the natives "the naked tree." This is a large deciduous tree with whitish green-gray bark, whose gleaming trunks are a great feature of the Gir Forest. Coupled with this is the "flame of the forest," a gorgeous tree with large spreading branches covered with great brilliant vermillion blossoms. The twisted and stunted teak trees, the various acacias, the Sterculia, the great splashes of vermillion, and the low carranda bushes and wendy trees make a jungle of great beauty, while the ground is covered with dry leaves of the teak, dry grass, and withered shrubs. The soil is thin, with frequent outcrops of rock, and quantities of quartz crystals.

Leopard, hyæna, pig, sambur, four-horned antelope, chinkara, and lion, as well as a few black buck are found there. All these creatures were seen with the exception of panther and black buck, although we did hear a panther "sawing" late one evening. There are plenty of cattle for lions and panthers to feed on apart from sambur and four-horned antelope. The lions sometimes stroll into the adjoining Baroda territory, principally during the rains, in order to get

into higher country, but they return to the Gir after the rains. As I have said, the estimated number of lions in the Gir forest at the present time is about 200. There are no bears as the feeding is unsuitable. In 1900 two were let loose in the Gir but did not survive the effects of swallowing wild fruits. There are no jungle fowl or spur fowl, but partridge are plentiful.

The average rainfall is about twenty inches, and from May to October the climate is extremely unhealthful. The region is a veritable death trap, full of malaria and very bad water. Undesirable citizens of Junagadh are generally sent there and are made forest guards or Gir police, as a penalty for their misdeeds.

This brings us to the shikaris (the native hunters), camp followers, and so on, who were with us. They appeared to be a very fine set of men, physically, and were wonderful trackers and shikaris. I have seldom seen better. Several of the men were supposed to have committed murder, and by their appearance the supposition seemed correct, but we were told the crime could not be definitely proved so the sentence was suspended to a period in service in the Gir. They were a motley crowd, but one could not help admiring their courage. They were good natured under the difficult conditions that faced them. Some of them had been badly mauled by lions and one of their number had been killed two years before.

The Gir buffaloes are the finest I have ever seen in any part of India. They are water buffalo and almost as fine as the wild species. If, while being hunted, a wounded lion should hide himself in an inaccessible place, some of the Gir buffaloes are put on his trail, and I am told it is an astonishing sight. They become infuriated and hunt him out, and unless he can escape, they will trample and gore him to death.

On our arrival at Camp Sasan we saw how complete the organization was.

AN INDIAN LIONESS

It is widely supposed that the Indian lion is maneless, but this is far from correct. The female is, of course, without a mane, as is the case in Africa, but the male obtained by the expedition had a fine, well developed mane

Everything possible had been done to insure success. We had brought with us our skinner from the border of Nepal, one named Panchan, a Tharu, who had been with Colonel Faunthorpe and me for the last seven years. I venture to state that no man in India has ever skinned a greater variety of Indian game than Panchan: many tigers, the great one-horned rhinoceros, the Sumatran rhinoceros, the tsine and thamin of Burma, elephants, sambur, and most of the Indian deer family, birds, porcupines, rats; he is trained to the last degree, and his skill is shown by the fact that we have in no instance lost a skin from the many specimens we have collected.

So our general equipment was perfect. All we needed was the lions. The method of hunting the Indian lion is not very exciting, except for the fact of seeing the animals, but we were fortunate in having a little episode which gave more amusement to the incident. His Highness, the Nawab, has forbidden anyone to shoot on foot since the tragic accident which befell Captain Carnegy, who while shooting with Lord Lamington was killed following a wounded lion. The shikaris go out, locate a lion by following the tracks; then *machans* (platforms) are put in trees, and the lions are, if possible, beaten up to the machans. It is not, as I have said, a particularly interesting way of shooting. Nevertheless, that is not the point. We wanted a lion and lioness and we had come many thousands of miles to get them. As I have said before, during the first few days nothing happened. We had seen one lioness or an immature male late in the evening, as we were passing down a jungle road in a motor car from where a beat had taken place. On the fourth day news came that a big lion had been seen. The shikaris were on his tracks. They had followed him for hours and could not leave him until he lay down for his siesta. The shikaris, who were posted certain distances apart, sent runners into camp, and in the meanwhile the machans were put up and the men placed in position. In the course of two or three hours the beat was ready to begin. In this particular instance, the only suitable place found for the machans was a jungle path about four feet across, with thick jungle on either side. A rather difficult position, for the lion could slip across this narrow path and it might be impossible to get a shot. We could hear the beaters a mile or so away, shouting, beating gongs; they came nearer and nearer; a noise was heard in the bushes, it came nearer and an old lion quickly appeared and was shot as he emerged from the jungle, a fine old full-maned lion, measuring 9 feet 1 inch. There was great excitement among the natives. They all gathered round, and we were told it was the biggest lion that had been shot in the Gir Forest in many years. Judging by the various photographs shown us of lions that had been shot during a period of twenty years, this was by far the finest specimen, especially as to mane.

We had permission to shoot a lioness. As one has only a few seconds in which to decide, it is very difficult to tell whether the animal being hunted is a female or a small male, on account of the absence of mane. However, we had to take the chance. A day or two passed by. We had been beating various parts of the jungle without success, until one afternoon, as we were returning to camp from a fruitless beat, motoring along a jungle road, we turned a corner; and there twenty yards ahead were nine lions. They quickly dispersed. None apparently was maned. The temptation was too great. Faunthorpe and I ran from the cars, separated, and went into the jungle. Fifty yards ahead on my left, in scrub jungle, I saw trotting what I believed to be a big lioness. I fired, and hit rather far

back in the ribs. The animal went by in Faunthorpe's direction. He fired and hit rather high in the shoulder. She still carried on. We began to stalk, whereupon the head shikari and several others accompanied by Major Tinley ran toward us and asked us not to go on. It was against orders. The shikaris would lose their positions. As we were intensely anxious to secure the animal, we went on for a few yards, and saw the lioness disappear into a nullah. We had to stop, however, and we decided that it was impossible for the animal to live long after the two shots it had received, and that it was only a question of waiting until morning when it would be found dead. It was not a pleasant thought to have to leave this animal, as in the event of its dying, a hyæna or some other denizen of the jungle might destroy it. However, nothing else was to be done. We returned to camp. Major Tinley insisted it was a small lion but Faunthorpe and I felt confident it was a lioness. In any event it was an anxious period. In the morning the shikaris went out and found the animal dead within twenty yards of where we had stopped stalking, with its head resting on the top of the nullah, forepaws advanced ready for a charge. There was joy in the camp. A lion and lioness had now been secured, both perfect specimens.

The skinning was watched with the greatest care. The skeleton was carefully preserved, and the skin finally packed up ready to be sent to New York. Our object was accomplished. The skins were in perfect condition, not a hair missing. We took them back with us on the train to Bombay and then proceeded to prepare them for their journey to New York. When sending skins long distances from hot climates, it is important to treat the hair side of the skin with some kind of poison or turpentine. We always used turpentine. This kills a very voracious beetle, called the Dermestes beetle, which bores into the skin and, if left undisturbed for any period of time, will entirely destroy the skins.

The limited area in which these lions live is slowly becoming more limited, and ultimately the lions of India will become extinct. The lions of the Zagros Mountains, of the Euphrates and Tigris will also have disappeared, but thanks to the generosity of His Highness the Nawab, the American Museum of Natural History will have specimens. Not only the skins will be on view at the Museum but also the skeletons of the lions which roamed through Asia—the lion of Daniel—the lion of Junagadh, all one and the same thing, are now in the Museum workshops.

I have spoken of the time it took to obtain permission to shoot these specimens—more than three years—and had it not been for Colonel Faunthorpe, I believe this permission could never have been obtained. He persistently followed every possible trail that could lead to the objective which eventually brought him in touch with Major Tinley. It was a great effort and the last he made for the American Museum of Natural History. On December 1st last, he passed on, but the lions will remain in the Museum as a memory to him—a splendid sportsman and a very gallant gentleman.

WILD LIFE IN DOMINICA

A Brief Outline of the Many Interesting Species Revealed to the Members Of Two Short Expeditions

By PAUL GRISWOLD HOWES
Curator of Natural History, the Bruce Museum, Greenwich, Connecticut

PHOTOGRAPHS BY THE AUTHOR

WHEN we think of the rich and wonderful fauna and flora of South America, or even such richly endowed islands as Trinidad, which lies close to the mainland, Dominica and the other small islands of the Antilles are of course comparatively barren.

It is true, however, that Dominica is richer by far than most of them and, notwithstanding her isolation, she has gathered and mothered the seeds of a flora at least, that is unsurpassed for its beauty and luxuriant growth. She is lofty, too, with massive, crumpled lava mountains that pierce the clouds and gather enormous quantities of rain. In the sunlight after a deluge, she steams and breathes off the humid vapors and perfumes of life and growth. Her forests gleam in golden light, and hundreds of hidden streams rush their liquid treasure to the myriad roots that bind her rocks and lava-soil together.

Unlike the islands to the north, she is near enough to the source of hurricane disturbances to miss their maximum fury. She has suffered wounds at their hands but not very serious ones, for her high mountains have protected her, and therein lies the secret of her greater wealth of animal life.

Again, to the north whole islands have been ravaged and swept by these terrible hurricanes, which have taken immense toll of the living inhabitants. On many of the other islands there is not a single bird, for instance, that could be called abundant. This is true also of islands such as St. Vincent to the south. It is Dominica's high mountains that have conserved her wild life.

In the mountains, particularly at an altitude around 1800 feet, birds are abundant, and although there are only fifty-seven varieties, some of which are seen only as migrants, their voices are heard on every side echoing through the forests and clearings. Birds are very fortunate in Dominica. Few of them except the pigeons and doves and parrots are ever killed for food by the natives; their natural enemies are an unimportant factor because of their scarcity, while food and shelter are both abundant and admirably suited to their needs.

Life was everywhere if one really searched for it, and my simple discoveries amazed some of our Dominican friends. In the water held by bromeliads were quite a number of *Amoeba radiosa*. In one plant there were large numbers of them and a single species of diatom. *Amoeba* also occurred upon dead leaves in a drain at the side of the Imperial Road. In such places I also found other Protozoa—beautiful microscopic *Difflugia* encased in faceted suits of brilliant crystalline substances, emerald green *Euglena*, *Chænia*, and countless *Paramœcium*.

Everyone who has visited the American tropics is familiar with the Cecropia tree, *Cecropia palmata*. It is very common in Dominica. In studying this species and examining the strange, divided interior, it was found that in every tenth or

twelfth or perhaps fifteenth division a quantity of water is held captive. This water, enclosed deep within the stem of the tree, supports animal life. Vials of the fluid taken from various trees and examined under the microscope proved to be housing four forms of Protozoa!

In a running brooklet I collected a brown species of flatworm. The worms are found on dead leaves and are much like the common *Planaria agilis* which is studied in every biology class. At the sides of the headlike anterior end, are processes like "ears" which are held upright and waved about as the animal progresses, as though of use as special sense organs. The two pits or eye spots in the head are oval, and a black, eyelike spot lies in the bottom of each.

These *Turbellaria* were very active day and night, and were strong enough to push their way about under a cover glass and finally escape from the weight unaided. As their chosen haunts undoubtedly dry up at times, they must encyst until the dry periods are over. In the economy of the brooklet they were used as food by larval *Aeschnid* dragon flies.

The earthworms are very abundant in Dominican soil. They are very active creatures, in many cases wriggling about with great rapidity when uncovered.

While digging in a bank in the heavy forest, I uncovered a perfectly round object three millimeters in diameter, which I took to be the egg of a small *Anolis* lizard. I placed it in a properly prepared vial to develop, and in three weeks it commenced to exhibit an orange coloring. A few days later this color had given way to a delicate pink, and red

THE OPOSSUM OF DOMINICA
This animal is often found in the orange groves, where it comes to eat the fallen fruit and particularly the seeds of both oranges and grapefruit

A GROUP OF FROG'S EGGS
The eggs of *Eleutherodactylus* are as clear as crystal, and their development may be watched by means of a binocular microscope. This picture shows the eggs greatly enlarged

A LAND SNAIL
Amphicyclotus amethystinus (Guppy) peculiar to Dominica, so far as is known has never been figured before

veins could be seen through the soft, thin shell. Four days later a perfect eighteen millimeter earthworm emerged from this egg. It commenced feeding at once in the earth within the vial and lived very well for some time.

To me the round form of the clitellum and the fact that it produced only one individual seemed a very interesting point.

Another strange earthworm protrudes a long, fleshy, viscid apparatus when disturbed. I found one of these progressing over a stone. When touched, it flashed out this odd device like the lash of a long whip. Very rapidly it came back along the worm's body, waved about behind it, and was then withdrawn again. The whip was as long as the body of the creature itself, but I could not ascertain whether it was solely for protection or also for gathering food from the protection of its burrow.

Molluscs are numerous and easily found, but only sixteen land forms and two from fresh-water streams were found on our two expeditions. In addition there

are of course many marine forms found along the coast.

Amphicyclotus amethystinus (Guppy) is peculiar to the island and has never been figured heretofore, but the species of greatest interest to me is a little enlongated creature called *Subulina octona* Brug. I first found it commonly in the uplifted strata about one hundred feet above the present shore line. Here the dead shells were plentiful, associated with coral, marine shells, sand, and fragments of spiny lobsters, for all the world as though the species had once been a marine form. Later, the same species was found alive and quite commonly as a true land form 1800 feet in the mountains. I understand that this snail was never a marine form, but why so many of them in the uplift above Roseau?

ANOTHER VIEW OF THE LAND SNAIL
(See opposite page)
Sixteen species of land snail and two from fresh water were found by the expedition members

Among the crustaceans, both the land crab, *Pseudothelphusa dentata* (Latreille) and the shrimp, *Atya occidentalis* Newport, occur, and are very good to eat. We frequently set minnow traps baited with salt fish, in any convenient stream

A FROG READY TO HATCH
Frogs of the *Eleutherodactylus* group have no free tadpole state, but hatch directly from the eggs as perfectly formed frogs. Very greatly enlarged

near our headquarters, and into these the shrimps would go with all haste. They are very tasty and a welcome change from the everyday food. At other times we would catch a mess of them by scraping the undersides of half submerged bowlders with a butterfly net, and cook them in a tin while we worked in the stream. Thrown into hot erbswurst, they are unsurpassed, and many a meal we had thus, fresh from the mountain water.

The land crabs are very good also, but as they feed upon some very bitter form of vegetation, it is necessary to pen them up for a week or two before they are used. They live in the streams as much as upon the land, and we even found them on the plateau at Milton far from any water. The specimens here would turn immediately upon our approach and give battle, with wild and awkward claws waving about in a most ridiculous manner.

They have been reported as migrating in vast numbers at one time of the year, to breed in the sea. As is so often the case in Dominica, no one, if actually pinned down, can tell you just when this occurs, and the fact that we found very tiny ones under stones along the rivers is strong evidence that they are born near by.

We found only one species of fish in most of the small mountain streams, a goby, *Sicydium punctatum* Perugia, that feeds entirely upon algæ which it browses from the rocks. In the larger rivers there are mullet and a few other species, and although there are plenty of shrimps and snails also, the mullet will not eat them, but will bite well on avacado pear.

AN ANOLIS LIZARD

These little reptiles live in the deep forests along the streams. They swim with ease and great rapidity

The goby mentioned is fitted with a suction disc upon its belly which enables it to cling to the rocks when the rivers are high. As these streams, when simply rain carriers, often dry up, I tried an interesting experiment to test the resisting power of this fish.

In a small glass box I placed a few algæ-covered stones and some of the stream water from which I had collected the fishes. One or two specimens were then placed in

A DOMINICAN GECKO

This weird looking creature (*Thecodactylus rapicaudus*) lives in the houses and comes out at night to catch the moths attracted by the lights. Note the creature's strange feet, perfected for clinging upside down

the box at a time, without plants of any kind except the algæ.

As the oxygen became partly exhausted, the fishes would jerk themselves up the side of the glass box by means of their suction discs and, here, with their heads entirely out of water, they would remain for a time breathing atmospheric air over their moist gills until revived, when they would return to the foul water again.

When the streams dry up, the fishes evidently burrow into the damp pebbles and sand and there await the return of the water after the next rain, meanwhile breathing the same air that we do.

Perhaps the most interesting creatures of all in Dominica are the little frogs of the *Eleutherodactylus* group. These are the ones that pass through no free tadpole state as most of their relations do, but hatch directly from the eggs as minute but perfectly formed frogs.

On our first expedition to the island, I was fortunate in finding two batches of eggs which were strung out upon the wet forest floor near our headquarters. The eggs are very large for so small a creature, but it must be remembered that the amount of food matter which they contain must be sufficient to supply the budding frog, from the time of the first appearance of the embryo until the finished creature steps into the world beyond its egg shell. In Dominica, it would seem that this is a perfect case of adaptation, for despite the enormous annual precipitation in the frogs' habitat, there are no natural pools in the forests, because of the steepness of everything and the resulting rapid drainage, while the rivers are either too violent or lacking in sufficient food material.

The eggs of these frogs are as clear as crystal and the whole development may

AN OPOSSUM ON A TREE FERN
This species looks very much like the Virginia 'possum. It is relished as food by the natives

be watched by means of the binocular microscope. For anyone who is interested in the study of glands in relation to growth and metamorphosis, here is indeed an ideal subject.

On our second trip in 1929, we found the eggs again almost on the same date that the first ones were obtained, and by coincidence, within a few yards of this site. The frogs occur from sea level to the tops of the mountains.

The only frog on the island that we were able to find is the large *Leptodactylus, follax,* called "Crapaud" locally. This is used to a great extent for food. They are caught and penned up, and strange as it may seem, they thrive on a diet of "French grass" which is nothing more nor less than the day flower, *Commelina Virginica.*

Reptiles are numerous in Dominica, but nothing poisonous occurs, even though Martinique, which is within sight on clear days, supports numbers of the deadly fer-de-lance. It is remarkable that this species has been unable to reach Dominica by way of the sloops which carry produce between the islands.

A beautiful snake is commonly found, which is one of the most docile creatures imaginable. It is harmless and cannot be induced to bite. This is *Leimadophis juliæ,* a species which inhabits the country from about 650 feet up to 1850 feet, and possibly higher. It, however, loses its docility as it gets older and then fights violently when captured.

We captured several Antillean boa-constrictors (*Constrictor orophias*) and successfully brought them home alive. They are extremely vicious and will inflict a bad wound if great care is not exercised in handling them. None of them ever became quiet or reconciled and finally all of them died of a malady which filled their jaw muscles with pus, causing their mouths to swell and shutting off their air supply. They actually died of strangulation.

They occur up to ten or eleven feet, but our largest was seven feet four inches in length. All of the boas were collected around 1800 feet in the moun-

tains and none of them were found in the forest itself.

Of the fifty-seven birds a few stand out particularly in my memories of this wonderful island. As I awoke from a sound sleep after my first night in the mountains, the full, rich song of the Dominican wren, *Thryothorus rufescens* floated in to me.

The singer sat outside my window, and there from his lichen-coated orange branch poured forth his melody to the rising sun beyond Diablotin. I have never heard a more beautiful song from the throat of any wren. Near by in a cover of ferns and dewy weeds, his mate spoke her approval in simple language, which sounded much like the chatter-talk of our wrens in America. Later I found this bird's song to be remarkably varied, and it was some time before I could recognize the variations as coming from the same species.

The mountain whistler, *Myiadestes dominicanus*, is a characteristic inhabitant of the high forests and mountain gorges. It does not appear to go below 1000 feet, but in the forests about our headquarters at 1800 feet it was seen on nearly every walk.

Its calls and songs vary greatly. Sometimes one hears a series of gorgeously clear, ascending notes, which echo through the green halls, as sweet and liquid as those from a silver flute. Again, the notes will be less perfect, even discordant and slightly out of key, but pleasing nevertheless. I like to hear the whistler best when all else is silent and no wind stirs and its voice issues from some deep and distant wooded canyon just at evening. It is then that its song fits into the environment as at no other time. It makes one feel the joy of the open and the tonic of a mountain world. One feels in addition, that here is the ideal setting of Nature, something, I believe, that everyone pictures more or less vaguely in his mind. When one finds the perfect setting and the perfect bird inhabitant together, the resulting song seems somehow to be just what one has hoped to hear.

A BLOSSOM OF THE DAY FLOWER
(*Commelina Virginica*)
This flower is an article of diet of the Dominican frog

(*Above*)

DOMINICAN SOIL FORMS RAPIDLY

Lichens at work upon the rocks preparing soil for the higher plants. Altitude 1800 feet

(*Left*)

STOUTLY ARMED PIN TREES

The protecting spikes that protrude along the trunks of these trees are very sharp and remarkably strong

(*Right*)

CECROPIA TREES

The stems of *Cecropia palmata* are hollow and divided into compartments, some of which contain water and microscopic animal life

(*Below*)

FERNS OF DOMINICA

Exquisite fern life such as this grows everywhere along the mountain roads that wind through the big forests

There is only one other bird that has ever impressed me just as this "siffleur" has done, and that is a mythical one that trills strange melody from behind the scenes at the opera. There is no earthly bird song like it, yet this bit of tin with a drop of water in it and the mountain whistler fascinate me and excite my imagination in the same way.

I was able to call the whistlers at times by imitating their call notes. They would assemble in the branches above, answering and peering in astonishment at me or venting their angry feelings upon one another. In the heat of the argument they would suddenly realize that it was all a fake and, finding themselves trespassers upon one another's chosen territory, would fly off in all directions with strange squeaks, stifled whistles, and snapping mandibles.

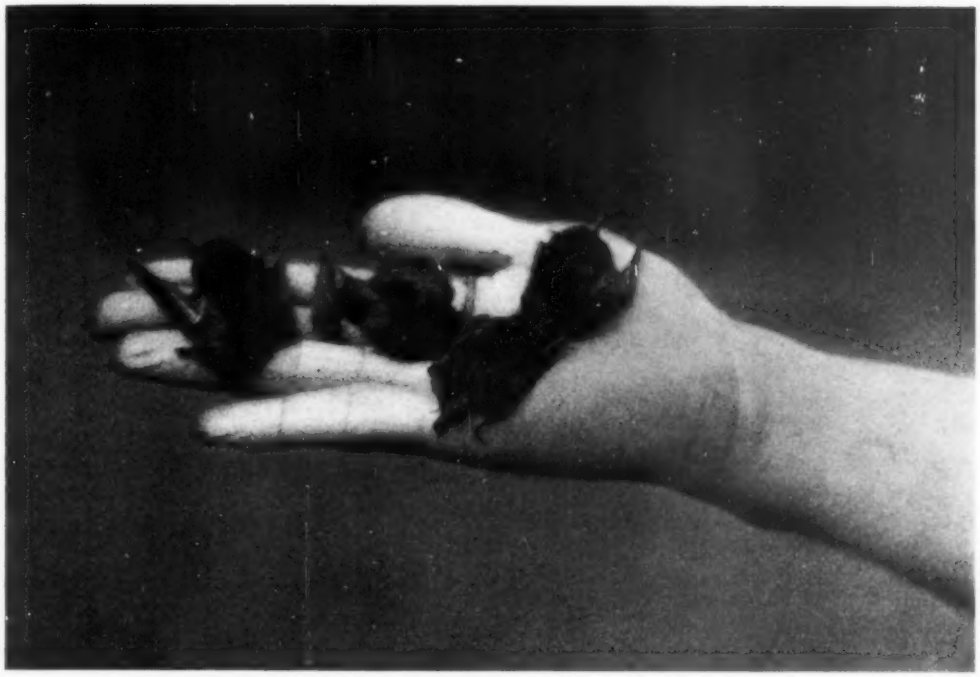
Mammals are not well represented in Dominica, as one would naturally suspect, but there are a few of considerable interest.

The black rat, *Rattus rattus rattus*, and the house mouse, *Mus musculus*, and rat, *Rattus rattus alexandrinus*, have been introduced as usual. There is one 'possum, *Didelphis marsupialis insularis*, greatly sought after by the natives and its flesh is often dried and smoked for future use.

A CAVE BAT
(*Myotis dominicensis*)
These small creatures live in the foulest fissures of the volcanic island. The two button-like processes to the left of the animal's nose appear to be connected with glands under the skin, which may have something to do with their success in such habitats

Agouti roam the forests also, but are not common, as they are on the mainland of South America. They are called "mountain rabbit," and are relished as food by whites and blacks alike. A wild pig is also found and sometimes descends from its mountain abodes to do much damage in the gardens of the natives. This is not a peccary but simply a domestic variety that escaped long ago and has become wild in the forests.

Bats are of course the dominant form of mammal life. Being winged, they have easily reached the island, and here is a field in which there is doubtless still considerable work to be done.



A HANDFUL OF CAVE BATS
These specimens came from a cave known locally as "The Stinking Hole." Note how small this species is

We saw nine species on our two expeditions, but only six were actually obtained. The huge, reddish furred fruit bat of the coast, another big species that was seen nightly about our headquarters, and what is doubtless the same form of fish bat one finds skimming the water at Trinidad in search of minnows, were not secured despite all our efforts.

The species collected were, *Molossus major*, *Monophyllus luciæ*, *Tadarida antillularum*, *Natalus stramineus*, another species of *Natalus* with a yellowish brown coat, and the tiny cave bat, *Myotis dominicensis*.

High in the hills above our headquarters is a strange funnel-like hole in the mountain which we called the "Stinking Hole." Here, in a deep cleft that one must enter from the top of a rise in the forest, and thirty-five feet below the surface, is another still narrower crack that leads into the earth. Some distance within the second crack the earth drops away into darkness with the floor deep below, and from here no one knows where the cave leads to. It breathes a foul air in one's face that is warm and sickening, like the breath of a huge living monster, while water drips and runs down continually upon the investigator over shiny black volcanic stones that stud the sides of the cavern.

Far within, it is dry and hot, and has become the abode of swarms of the little cave bats, which in some unaccountable manner are able to withstand the foul fumes. We collected many specimens by means of a butterfly net, but were soon forced to retreat to the upper air, as the gases from the interior of this cave made us feel sick and dizzy.

In 1929 we made a trip to the Glo Manioc cave, from which much guano has been taken by the natives in the past and which we had always been anxious to visit.

This cave is situated west of the Layou River and about 200 feet up in the cliffs, one half mile west of the old abandoned plantation known as Glo Manioc. One may walk down the bed of the river upon the huge bowlders and cross over when the entrance to the cave comes into view as a carved, arched doorway leading into the gray wall of the cliff.

We climbed up a deserted and heavily grown path left by the guano gatherers and descended afterward by another and better route to a small river which empties into the Layou.

As we neared the entrance to the cave, a distinct odor of sulphur was noted, but at no other time either within or outside the cave was this noticeable; there is doubtless a small vent near by, as these are not uncommon in Dominica.

The opening to the cave is seventy-five feet in width and ten feet high. It is partly blocked by great chunks of porous lava which have either been loosened from the vaulted roof of the chamber or heaved up from below when this great mouth was still breathing forth sulphur and gas and boiling stuff from the interior of the island. The cave runs back for some distance and slopes steeply to the rear, where more large fragments of lava are heaped together, in places forming smaller caves within the mother cave.

The floor is of rocks and lava and disintegrating material, quite dry and even dusty in many places despite the water which seeps through the roof and drops to the floor from the ends of little stalactites. Unfortunately the specimens were lost and no analysis can be made unless another trip to the cave is made.

THE BAT CAVE AT GLO MANIOC
The viewpoint of this picture is from the small river that runs into the Greater Layou near by

The rocks lying upon the floor are beautifully tinted by one-celled algæ, those nearest the entrance being brilliant green, while the ones upon the rocks farther in from the source of light are duller in color and other rocks are tinted with reds and browns. The green algæ contain chlorophyll and therefore manufacture their own food materials. Naturally they grow best close to a brilliant light source.

There were very few bats in the cave. We

found one mass of them quite near the entrance, from which I caught fifty or sixty in my net. These I allowed to escape, expecting to get plenty of others later on, but to our surprise this was the only colony in the cave. There was very little guano upon the floor, and it is my opinion that the natives finally drove the main colony away and that this single small group is the nucleus of a new colony.

All of the bats here were *Myotis dominicensis*, the little cave bat, and the same as we found in the Stinking Hole in 1926, but the specimens from Glo Manioc showed a slightly smaller wing spread, although of the same sex (male) as the ones from that foul cave.

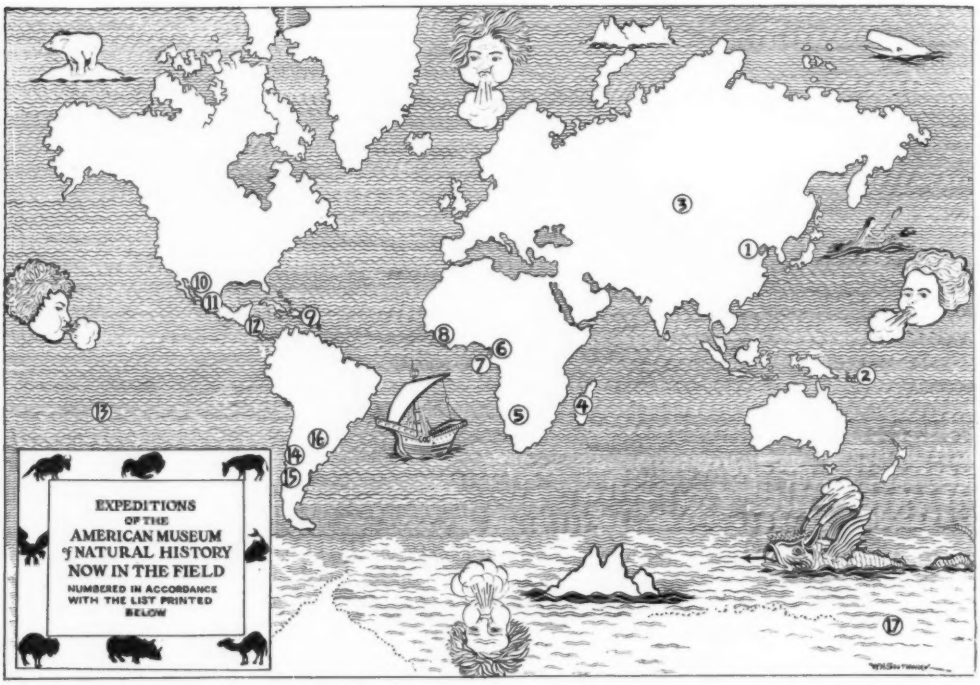
MR. CUMMINGS AT THE ENTRANCE TO A BAT CAVE
Tiny stalactites were hanging from the roof of the chamber, and beautiful algæ grew upon the rocks inside

A remarkable observation made in the present cave was the fact that the Dominican wren, *Thryothorus rufescens* was frequenting the guano deposits under the roosting place of the bats for the purpose of obtaining bits of undigested insects from the droppings. Under the microscope these droppings were found to be rich in such food matter, and the wrens have found this out to their advantage. The maggots which collect in the guano are another source of food.

After the bat colony had been disturbed, a small cloud of bat flies went whirling about within the cave, but these disappeared with the bats and did not return.

In 1926 we secured the rare and desirable *Natalus stramineus*, a pale, delicate bat with a very peculiar profile. This was the only one seen, but in 1929 a bat flew into the house which proved to be another species of *Natalus* with a greater wing spread and fur of a different color.

Thus it will be seen that there are still very interesting things awaiting the investigator in Dominica, and that our two intensive expeditions have not exhausted the possibilities.



1. Central Asiatic; 2. Whitney South Sea, Solomon Islands, for birds; 3. Morden-Graves, Turkestan, for mammals; 4. Madagascar, for birds, mammals, and fossils; 5. Vernay, to Africa, for mammals; 6. Columbia University-American Museum, to Africa, for anatomical study; 7. Thorne-Correia, Gulf of Guinea, for birds; 8. Murphy, to Liberia, for birds; 9. Heilprin-Hassler, Haiti, for reptiles; 10. Frick-Rak, New Mexico, for fossils; Frick-Falkenbach, Nebraska, for fossils; 11. Vaillant, Valley of Mexico, archæological study; 12. Chapman, Barro Colorado, for bird study; Legendre-Carter, to Eastern Panama, for birds and mammals; 13. Shapiro, Polynesia, physical anthropology; 14. Olsen, South America, archæological reconnaissance; 15. Ottley-Anthony, South America, biological reconnaissance; 16. Naumburg-Kaempfer, Southeastern Brazil, for birds; 17. Byrd, Antarctic

AMERICAN MUSEUM EXPEDITIONS

EDITED BY A. KATHERINE BERGER

It is the purpose of this department to keep readers of NATURAL HISTORY *informed as to the latest news of Museum expeditions in the field at the time the magazine goes to press. In many instances, however, the sources of information are so distant that it is not possible to include up-to-date data*

WORD from the Columbia University-American Museum Expedition to Africa indicates that all its members are in fine health and spirits, and that they expect to be back in New York about the middle of February.

The November–December number of NATURAL HISTORY noted the taking of the first big gorilla by Leader Harry C. Raven, after an exciting charge from the animal. The following extracts from letters received by President Osborn describe the most recent activities of the expedition.

CHABINDA, IN THE MOUNTAINS WEST OF LAKE KIVU

Shortly after Raven had returned here to camp with his big male No. 1, we all had an opportunity to spend two hours late in the afternoon and three hours the next morning spying through the bushes on a party of gorillas which were literally within hearing of camp. Many interesting observations have been made as to their habits, but unfortunately no opportunity to get motion or still pictures of the living animals presented itself. At this time Raven shot and killed a second adult which he took to be a large female but which turned out to be a male. Professor McGregor and others took many cinema and still pictures of this specimen, showing many important details, also excellent casts of the bust, hands and feet. It was necessary to remove the contents of the digestive tract, so that we all had an opportunity to see the enormous quantity of ingested food, the very man-like vermiform appendix, and numerous tapeworms and other internal parasites.

Some ten days ago Raven took Gorilla No. 1 on a long journey by auto-truck to Uvira, where he left him, pending shipment via Dar-es-Salaam. Now that we are sure the second one will not go bad on the way home, we will shortly take him with us for shipment along with No. 1. We are sending both to be stored temporarily in the refrigerating room at P. and S.

Since then we have made many excursions to get photos of the living gorillas, but have not as yet succeeded as they live in very dense brush. At present Raven and Engle are on a side trip to a high mountain about six hours' journey from here, where it is reported gorillas inhabit the bamboo forest, where photography may be more possible. Meanwhile McGregor and I are guarding camp and making local excursions whenever the rain permits.

P. S. Sept. 15th. Raven and Engle returned some days ago from their strenuous trip to Mt. Cahusi. They found apparently ideal country for gorillas there, with fine bamboo forests and original or open forest not so much choked with underbrush as this is; but *no traces* of gorillas. However, they shot several monkeys, including one with a vertical white band on his nose, which may be the very rare *Rhinos-*

tigma. Meanwhile I have been making almost daily excursions in this vicinity, searching for recent traces of gorillas, but the elephants which were here a couple of weeks ago have left a labyrinth of trails and trampled the gorillas' favorite nesting places, so that the Mambuti hunters tell us they think the gorillas have all moved away to the south and west. And now we must begin immediately to move camp, so as to take up our long journey to the West Coast.

The movie and still photos are being developed and stored away as fast as possible. They are nearly all in excellent shape, so that by the end of the trip we should have a great deal of material for lectures and illustrations.

CONGO RIVER, 1 DAY'S RUN ABOVE COQUILHATVILLE.

We had to leave the Kivu region about September 20 and have been traveling or waiting for boats or trains ever since, except for a week's side trip from Stanleyville, after chimpanzees. This side trip to Benalia, 85 miles north of Stanleyville was intensely interesting and yielded many pictures of the natives. Raven worked until he was worn out hunting chimpanzees in a locality where they are often abundant, but luck was against him and we had to leave with only one instead of four. However, we may still possibly get them elsewhere.

AT THE PORT OF DUALA, FRENCH CAMEROON, November 7, 1929.

We are waiting to go ashore into the French Cameroons for the last part of our African journey and our thoughts naturally turn toward home. We had a singularly interesting trip across Africa, mostly by steamboat, leaving the mountains of the Kivu September 20. What a gorgeous panorama of mountain and lake, primal forest, river jungles, the mighty Congo itself, for many weeks past! I have kept a record of crude sketches of these scenes and have studied the topography and geology as far as possible, so that I have seen a section across Africa from the east coast to the west coast. And with what delight I have studied the intensely human "indigenes," truly our black cousins, and more akin to me at least than the cold blooded Mongolians. How many memories of walks in native villages we shall treasure and what an immense range of variation in details, with underlying racial characters, have passed before us. Just when one is ready to say "Well, this is the *most perfect* gorilloid human nose of all," another still more perfect will appear.

During the long waits for boats and trains we have made side trips whenever possible, which have yielded to Mc Gregor, a great store of cinema records.

This afternoon we shall reach Duala, and plan to go by train or camion eastward to Yaounde, where the Governor resides. After making arrangements with him, we shall probably go southeastward toward the Gabon, east of Eblowa, where gorillas are said to be numerous. But in Africa one can rarely learn in advance the precise local conditions so our detailed plans may be modified to suit. But we shall make every effort to be back here in Duala in time for the Dec. 19th boat for Bordeaux, or at latest the one leaving here Dec. 30, in time to get us home before February 1.

ALTHOUGH, owing to the regrettable attitude of the Chinese toward research, the Central Asiatic Expedition was unable to continue its field work in 1929, Dr. Roy Chapman Andrews has remained in Peking working upon the narrative volume of the expedition, "The Conquest of Asia." It is hoped that conditions will so change that the expedition can continue its work in 1930.

The other men of the expedition have returned to America and are devoting their time to studying the collections obtained. The manuscript for Volume IV on the Permian of Mongolia is practically ready for the printer, and will be published in 1930. Prof. Henry Fairfield Osborn and Mr. Walter Granger are engaged in the study of the palæontological material, the results of which will appear in Volumes VI and VII. Profs. Charles P. Berkey, Frederick K. Morris, and Leslie E. Spock have the manuscript nearly completed for Volume III, which is a continuation of Volume II on the Geology of Mongolia.

THE Morden-Graves North Asiatic Expedition has been successful in obtaining six skins and five skeletons of the rare saiga antelope (*Saiga tartarica*) from the Steppes of Russian Turkestan, together with specimens of plants and other accessories for the construction of an exhibition group at the American Museum. This will be the only habitat group in America of the saiga.

The saiga and the *Jerboa alactaga* are the sole survivors of the Ice Age fauna that invaded Europe from the cold steppes of Asia with the woolly mammoth. The saiga once abounded in Central Asia, but is now rapidly becoming extinct, due to its relentless pursuit by the Chinese who believe that the horns of the saiga possess medicinal properties.

The difficulties encountered in obtaining the antelope were far greater than had been anticipated. Much of the time the members of the expedition were without proper food, and the water, even when boiled, was very bad. The winds sweeping across the steppes were so fierce that tents could not be used at night, and the party was without shelter whenever it was not possible to stop at the native huts.

Under these conditions Mr. Morden spent ten days in the saddle, pursuing the saiga. The strain told greatly upon his health; for two weeks he carried on and covered about two hundred and fifty miles, trying to shake off the results of the hardships suffered. Finally, a cablegram was received at the Museum early in December announcing that Mr. Morden's illness necessitated his immediately abandoning his plans to go to Siberia, and that he had gone from Moscow to Paris for treatment. He hoped to rejoin the expedition again in January.

In the meantime Mr. George Goodwin of the American Museum's department of mammalogy went to meet Mr. George Graves, who took charge of the expedition in Mr. Morden's absence.

Mr. Morden has already secured for the Asiatic Hall of the American Museum a splendid collection of the *Ovis poli* of Mongolia and the Thian-shan ibex.

AT the end of December Arthur S. Vernay sailed from New York for England on his way to Cape Town to begin his expedition to the Kalhari Dessert. The main object of the expedition is the collecting of specimens of large mam-

mals. These are to be divided between the Field Museum of Natural History and the American Museum. Mr. Rudyerd Boulton, who is to be a member of the party, and who is now collecting for the Carnegie Museum in southern Rodesia, will collect birds for the Carnegie Museum and the American Museum. At Cape Town Mr. Vernay will be joined by Herbert Lang who has been making preparations for the trip.

The party will proceed by motor truck from the railroad toward the region about Lake Ngami, where work will be carried on for about four months.

ON Christmas Day, a cable was received from Curator Harold E. Anthony, and Mr. Gilbert Ottley stating that they were in Puente Inca, Argentina, and that by January 1 they would reach Santiago, Chile. Mr. Anthony and Mr. Ottley are making a reconnaissance of South America with the object of collecting at the type localities as many species of mammals as is possible. They will return up the east coast of South America and are expected to arrive in New York during the month of April.

THE Byrd Antarctic Expedition.—On the occasion of Commander Byrd's dramatic flight on November 28 and 29 from Little America to the South Pole, President Osborn and the members of the scientific staff of the American Museum sent the following congratulatory radiogram to the intrepid leader of the Byrd-Antarctic Expedition:

DECEMBER 3, 1929.

TO COMMANDER RICHARD E. BYRD,
LITTLE AMERICA.

The members of the staff of the American Museum of Natural History send united congratulations to yourself and your associates upon the completion of the triumphant flight to the South Pole.

From our own field experience in many lands and seas, we have a clear appreciation of the patient and faultless planning necessary for such monumental achievement. We hail, therefore, the perfect climax of your campaign and extol the judgment, courage and teamplay that made it possible.

Your flight writes the opening page in a new history of science on the vast Antarctic Continent. We do not forget, moreover, that you and your consecrated fellow-workers are extending knowledge day by day and building through the laborious routine of duty, the foundation for your brilliant exploration by air. You have justified the confidence of your countrymen, and to the fulfillment of all your plans our hopes are with you.

HENRY FAIRFIELD OSBORN
President

A few days later President Osborn received the following reply by radio, which was forwarded by the *New York Times:*

LITTLE AMERICA, DECEMBER 10

FOR HENRY FAIRFIELD OSBORN
PRESIDENT, AMERICAN MUSEUM OF NATURAL HISTORY.

Your radio has delighted us. It is most generous and more encouraging than you can perhaps realize since we have tried so hard to produce real scientific results. A message like yours from such a distinguished scientist as yourself makes us feel that our efforts have not been in vain. Please accept my deep appreciation and warm regards.

RICHARD BYRD

LATEST advices from the Whitney South Sea Expedition state that all its members are well and are expecting to be through with bird collecting in the Solomon Islands by March, including Malaita, where no naturalist has ever collected before. The next objective will be the Japanese Mandate Islands to the northward.

AVERY creditable piece of bird collecting has been done by the Thorne-Correia Expedition which has been visiting two Spanish and two Portuguese islands in the Gulf of Guinea. Word from Mr. Correia, early in December, said that he was on his way to Annobon, one of the Spanish islands. On Fernando Po, the other Spanish island, there is a great scarcity of water from the upper part of the forest zone to the highlands. Mr. Correia is negotiating with the governor of the islands for men to cut trails and carry water to the top so that this region can be explored by the expedition.

Mr. Thorne has extended his contribution so that there will be sufficient funds to complete the task in the Camaroon Mountains on the African mainland, thus for the first time making possible a valuable and adequate series of the birds of these islands, with excellent photographs and notes.

THE Tanganyika Expedition.—Messrs. J. Sterling Rockefeller and Charles G. B. Murphy, accompanied by Allan L. Moses as preparator, started from Dar-es-Salaam in August, 1928, on an expedition intended largely to contribute specimens to the bird collections of the American Museum. Recent cables inform us that they have traversed the continent from the East Coast to the lower Congo River, and that Messrs. Rockefeller and Moses plan to return directly to New York.

Mr. Murphy, in company with Mr. R. H. Drinkwater, is proceeding to Liberia with the aim of securing further specimens of birds from a region as yet almost unrepresented in our collection.

The expedition was named the Tanganyika Expedition because its efforts were to be directed largely in the vicinity of that great lake. Some six months were spent in Tanganyika Territory, partly in hunting, partly in collecting birds. Next the party proceeded to Marungu, a highland country on the southwest side of Lake Tanganyika. The mountains here rise to over 6000 feet, being largely grass-covered, but clothed on their lower slopes with savanna woods, or extensive groves of trees with grass growing almost everywhere beneath

In 1883 the region was traversed rapidly by the talented ornithologist Dr. R. Böhm, and nearly all that was known of its birds came from Böhm's notebooks, for he succumbed to fever the following year in the Katanga. Although a few collections of birds were made by others along the shore of Lake Tanganyika, the fauna of the highlands remained imperfectly known.

Our Tanganyika Expedition therefore devoted its entire efforts for three and a half months to a survey of bird-life in these highlands, which they crossed twice, going south to the Rhodesian border. The resulting collection numbered 597 specimens and amply fulfilled our hopes. A number of species were secured which had not previously been known to occur within the boundaries of the Belgian Congo, and when the collection has been studied more closely it will reveal a great deal more about the avifauna of this southeast corner of the Congo, and its relation with eastern Africa. Together with their collection, Messrs. Rockefeller and Murphy have sent back a very complete report of the topography and vegetation of the country, and a field-catalogue with many notes on the birds observed.

After shipping their collections to America by way of the east coast, the party turned northward to the valley of the Ruzizi River, flowing from Lake Kivu. To the west of this valley runs a mountain ridge some 10,000 feet high, where very few birds have ever been collected, save by the Austrian explorer, Rudolf Grauer.

On these mountains they again began collecting, and after crossing the ridge they entered the southeastern angle of the great Congo forest, reaching Kindu on the Lualaba River. They report having made another excellent collection of birds between Kindu and the Ruzizi Valley, in which numerous rarities will surely be found when it reaches the Museum.

Mr. H. C. Raven writes that at Uvira he had the good fortune to encounter Mr. Murphy, whose happy features were wreathed in a generous black beard. This was just before the Tanganyika Expedition started from the Ruzizi for Itula and Kindu. At last reports, the party was in good health and had come down the Congo River to Matadi.

THE Straus–Nyasaland Expedition.—Mr. and Mrs. Rudyerd Boulton have completed four months of ornithological work in the vicinity of Lake Nyasa, made possible by the generosity of Mrs. Oscar Straus. Early in 1929 they accompanied Mrs. Straus and Mr. Edward Schafer, Jr., on their journey up the Nile and through Uganda and Kenya Colony.

From Nairobi Mrs. Straus turned homeward, the Boultons proceeding by steamer from Mombasa to Beira. Thence they gained Lake Nyasa, and began collecting on Mt. Rungwe, north of the lake. A number of other localities were subsequently visited, so that Nyasaland will no longer be without representation in the American Museum's bird collections. The country is of great interest because of its diversified nature, the separate mountain districts offering homes to many peculiar birds. The Boulton collection is awaited therefore with pleasant expectations.

THE greater part of 1928 and 1929 was spent by Mr. F. G. Carnochan and Mr. G. H. Russell, of New City, N. Y. in Tanganyika Territory, Kenya Colony, and Ruanda, studying the natives, their medicinal herbs, and especially the snake-societies among the Wanyamwezi. Mr. Carnochan, deeply interested also in the animal life of the region, remembered that he could help the American Museum by securing specimens, and thus brought together a considerable collection of mammals, birds, and reptiles. On his return he very kindly donated to the American Museum 379 skins of birds, as well as many mammals and some herpetological specimens.

AFTER an extended trip to Cuba, Arizona, and Utah, Barnum Brown returned to the American Museum December 20. His expedition to Arizona and Utah was under the auspices of the Museum of the University of Pennsylvania. One party of the expedition, directed by Dr. J. A. Mason, excavated in the Pueblo ruins on Navajo Mountain in Southern Utah.

Mr. Brown's party, accompanied by Gilbert E. Gable, investigated Triassic dinosaur tracks on the Navajo Reservation, uncovering 300 tracks representing four distinct species at one spot in the Painted Desert on the Little Colorado River near Cameron.

The most important results of the expedition was the discovery of two skeletons of Jurassic dinosaurs in Utah—a *Brontosaurus* and a new genus of carnivorous dinosaur. Both skeletons were examined and re-covered to await future excavation by an American Museum expedition.

ON December 29, Mr. Walter W. Holmes, field associate in palæontology, left the American Museum to continue explorations in the Pleistocene deposits of southern Florida during the winter.

ON January 2 Mr. Ronald Olsen left New York to make an archæological reconnaissance in Ecuador, Peru, and Bolivia. The major portion of his time will be spent in Peru. Mr. Olsen will study cross sections of the Andean region in several places, starting from southern Peru in the Lake Titicaca region. The purpose of his trip will not be for collections, but rather to study the refuse heaps to establish the sequence of cultures, which, in those countries of South America have never been clearly established. Much of the ancient culture has been attributed to the Inca period, which in reality was only four or five centuries in duration. The material in the Museum would indicate much older civilizations.

THE Angelo-Heilprin Expedition to Santo Domingo.—Mr. William G. Hassler is visiting Santo Domingo on a grant from the Angelo-Heilprin exploration fund. He is collecting and infiltrating reptiles and amphibians in the field. The process of infiltrating whole specimens with paraffin was recently worked out in the department of herpetology and experimental biology at the American Museum. It consists essentially in replacing by paraffin the water in an animal's tissues. The animal is posed in its natural surroundings with all of its tissues intact, then it is run through a series of baths which make the entire specimen a permanent preparation. This is the first time that any expedition has gone into the field to prepare specimens by the new infiltration method.

Incidental to the work, Mr. Hassler has been collecting specimens for the Museum departments, especially for herpetology and experimental biology. The development of lizards is being studied in the Museum laboratories, so Mr. Hassler made an effort shortly after his arrival at Santo Domingo to collect numbers of lizard eggs to be shipped alive to the Museum laboratories. Mr. Hassler writes,

> The first day after I arrived I told the native boys I wished lizard eggs and they brought in over 250 at once. Most of these were eggs of *Sphaerodactylus*, although some eggs of the larger species of geckos were included. The second night when John, my guide, and I returned from exploring, we were surrounded by a howling mob of boys, each with a handful of eggs. When the excitement was over I found that I had some 700 additional eggs, and there was a large percentage of big gecko eggs. I closed the egg market at once for an indefinite period.

In the course of the next few weeks Mr. Hassler shipped to the Museum a large series of living tree snakes, forest lizards, and various burrowing species of lizards and snakes. The *Amphisbaena* and *Sphaerodactylus* lizards illustrating the article "What Produces Species?" in this issue of NATURAL HISTORY, were collected by Mr. Hassler. The living specimens are being studied in the laboratories of experimental biology and are yielding important life history data.

ON December 12, Dr. Frank M. Chapman left for Barro Colorado, Canal Zone, where he will be until April, continuing his research and photography work.

THE Heilprin-Yucatan Expedition.—Mr. Robert T. Hatt, of the department of mammalogy, and Mrs. Hatt (Marcelle Roigneau), of the department of comparative anatomy, at the American Museum, returned on December 22 from their expedition to Yucatan. The first few weeks were spent at the ruined Maya city of Chichen-Itza where mammals and reptiles were collected. Following this, Mr. and Mrs. Hatt explored a large number of caves in Yucatan's low mountains, for the remains of extinct animals. Fossils were obtained in every site excavated, though numbers were small and none of them were of great antiquity. This expedition was supported by a grant from the Angelo Heilprin Fund. Doctor Heilprin himself was greatly interested in the geology of Yucatan and has written on this subject.

A THREE-months' leave of absence has been granted to Mr. Francis L. Jaques of the American Museum's department of preparation in order to permit him to study bird life and do extensive sketching along the shores of the Gulf of Mexico and up the Atlantic coast.

NOTES

JOHN CHAMPION FAUNTHORPE

ON December 1, last, there died at Lucknow, India, from pneumonia, one of the great benefactors of the American Museum.

Col. J. C. Faunthorpe, former Commissioner of Lucknow, originated the idea of the now famous Vernay-Faunthorpe collection of Asiatic mammals that is being mounted for exhibition in the great Asiatic Hall of the American Museum. This hall will be opened to the public in the autumn of 1930. It was hoped that all the Maharajahs and leading officials of India who had assisted in the securing of the collections could be present with Colonel Faunthorpe at that time.

It had been the dream of Colonel Faunthorpe's life to make this collection absolutely complete, and, backed by the enthusiasm and generosity of Arthur S. Vernay, he planned expedition after expedition to East India and Burma. On

some of these Mr. Vernay accompanied Colonel Faunthorpe, while others were carried out by Mr. Vernay alone.

Colonel Faunthorpe was born in 1872, and was graduated from the famous Balliol College, Oxford. He was appointed Commissioner of the Lucknow Division in 1920. This same year, while visiting President Osborn at the American Museum of Natural History, he observed that the collection of Asiatic mammals was not of great value. Shortly afterward Colonel Faunthorpe wrote a letter to President Osborn offering to arrange for a representative collection, at least of the wild animals of the plains.

That offer was followed in November, 1921, after considerable correspondence, by a letter from Mr. Vernay saying that Colonel Faunthorpe had broached this plan to him, and that he would be very glad to join in the undertaking. This was the beginning of the Vernay-Faunthorpe expeditions that have resulted in securing for the American Museum the finest collection of Asiatic mammals in the world.

Colonel Faunthorpe was *persona grata* with, and knew all the chief officials in India. Through his personal friendship he was able to enlist the interest and coöperation of the Maharajahs of several of the great provinces. This led to the American Museum's expedition into Mysore for wild elephants and for the great Indian rhinoceros from Nepal. With this beginning Colonel Faunthorpe devoted himself continuously, in companionship with Mr. Vernay, to assembling the Asiatic collection.

Colonel Faunthorpe was typical of the race of quiet Englishmen who accomplish so much in all parts of the world. He was a man of very few words, and what he did was done in the quietest possible manner. He had a fine sense of humor, was an excellent naturalist, and a keen observer of the habits of wild game. The last great achievement of Colonel Faunthorpe and Mr. Vernay was the collection of the animals for the Indian lion group. Permission to secure specimens of this fast disappearing race of lions, was exceedingly difficult to obtain, and for three years Colonel Faunthorpe persistently endeavored, through every possible channel, to secure this great privilege, that the American Museum collection might be completed. How he finally succeeded is told in this issue of NATURAL HISTORY, by Mr. Vernay, in the article entitled "The Lion of India."

It is the hope of President Osborn and the American Museum that a volume may be published commemorative of the manner in which the Vernay-Faunthorpe collection of Asiatic mammals was made a reality.

ASTRONOMY

THE astronomy radio broadcasts under the auspices of the Amateur Astronomers Association on the Saturday afternoons of December from 5:30 to 5:45, which were made possible through the courtesy of WOR, elicited so many letters of approval on the part of the vast unseen audiences, that WOR decided to continue the broadcasting during January and February.

On January 4, Mr. David Pickering talked on "The Romance of Variable Stars." "Star Lore and Astronomy of the North American Indian" was the subject of Mr. Stansbury Hagar's talk on January 11. Dr. E. E. Free discussed "Einstein and the Stars" on January 18, and Dr. Palmer H. Graham told about "Comets and Meteors" on January 25.

The radio program for February follows:

February 1. Capt. Robert A. Bartlett. "Navigation by the Stars, in the Polar Seas."

February 8. Mr. Oliver P. Medsger. "The Moon."

February 15. Rev. John A. Ingham. "The Earth as a Timekeeper."

February 22. Mr. William Henry. "The Sun and Sunspots."

ON January 8 another record audience enjoyed the second showing of the remarkable motion pictures on the Einstein Theory of Relativity.

This repetition program had been arranged in response to the numerous requests that came pouring in to the president and secretary of the Amateur Astronomers Association after the November 6 projection of the pictures. On that occasion more than 3000 people flocked to the Museum, necessitating two showings of the pictures during the evening.

A lecture illustrated by motion pictures and slides on" Ether Drift and Relativity," by Prof. Dayton C. Miller of the Case School of Applied Science, Cleveland, followed on January 22. This lecture was the same as that given at the Royal Institution, London, and many universities here.

During February and March the speakers scheduled are:

February 5, Dr. Willis I. Milham, Professor of Astronomy, Williams College, "Time and Timekeepers." (Illustrated.)

February 19, Dr. Harlan T. Stetson, of Perkins Observatory, Ohio Wesleyan University, "Eclipse Hunting." (Illustrated by motion pictures and slides.)

March 5, Dr. E. E. Free, "Mars." (Illustrated.)
March 19, "Dr. Ernest W. Brown" of Yale University, "Time and Tide." (Illustrated.)

CONSERVATION

BIRD Refuge Established in Montana.—By recent Executive order, President Hoover has set aside, as a refuge and breeding ground for birds, a 12,234-acre tract at Benton Lake, in Cascade and Chouteau Counties, Montana, near the city of Great Falls. The new reservation will be known as the Benton Lake Bird Refuge and will be administered by the Bureau of Biological Survey of the United States Department of Agriculture.

EXPERIMENTAL BIOLOGY

COLOR Change in Lizards.—Prof. Charles E. Hadley of the New Jersey College for Women has recently been carrying on in the laboratory of experimental biology of the American Museum, various investigations concerning the mechanism of color change in lizards. Light, temperature, moisture, and several internal factors control the expansion and contraction of the pigment cells in the skin of lizards. Professor Hadley is determining which mechanisms play the chief rôle in the species under his observation. The laboratories of experimental biology afford facilities to competent investigators who have need of living material in pursuing their investigations.

AMERICAN MUSEUM BROADCASTS

UNDER the auspices of the department of public information of the American Museum of Natural History a series of radio talks was arranged for in October, to be broadcast by Station WRNY at 5 P.M., on the first and third Sundays of each month. A page of illustrations chosen by the head of the department giving the broadcast, appears in the *Herald-Tribune* on the same day, and is accompanied by an announcement that a talk upon the pictures will be given in the afternoon.

This is a form of publicity new to the Museum, and has met with a degree of success far beyond that originally hoped for. The curators have given generously of their time in the choosing of pictures and the preparation of talks, and have bent their energies enthusiastically to the work, with the result that every effort has been made, both by the *Herald-Tribune* and Station WRNY to advertise the programs. The great number of letters received is ample evidence of the popularity of these programs. Thus far the following have given talks: Mr. Barnum Brown, Mr. James L. Clark, Dr. Clyde Fisher, Dr. G. K. Noble, Dr. Roy W. Miner, Dr. Robert Cushman Murphy. Dr. Margaret Mead, Mr. T. Donald Carter, Mr. Herbert P. Whitlock, and Mr. C. M. Breeder, Jr.

So great has been the appreciation of these talks that Station WRNY asked for, and has been granted, a series of Saturday morning talks at 11:30 each week. This series was inaugurated by Mr. James L. Clark on Saturday morning, December 28.

In addition Station WJZ began broadcasting on January 6 a series of weekly Monday afternoon talks at 5:30 P.M. The first three of these were given by Mr. Herbert P. Whitlock, on precious and semi-precious stones.

A series of radio talks given over WNYC at 5:45 P.M. were arranged for in November, December, and January, as follows:

Nov. 19, Dr. Sherwood, "The Museum and School Service."

Dec. 3, Mr. Carr, "American Museum Nature Trails at Bear Mountain."

Dec. 17, Mr. Mann, "Indoor Nature Trails."

Dec. 31, Mr. Carr, "An Animal Engineer: The Beaver."

Jan. 14, Dr. Smith, "Museum Jungle Life."

Jan. 28, Dr. Fisher, "Origin of the Earth."

Morning talks, given for the benefit of high schools, were broadcast from the Museum on January 7 and 24, at 11 A.M. Slides were shown at the schools to illustrate the talks, and a duplicate set of the slides was used simultaneously at the Museum by the speaker. It is hoped that these morning talks will prove of sufficient value to the schools, to warrant their continuation through the school year.

HONORS

THE degree of Doctor of Laws was recently conferred by Indiana University on Dr. Clark Wissler, curator-in-chief of the division of anthropology, American Museum. President W. L. Bryan in conferring the degree said in part:

> I think of you when you were a student of psychology here. You have so wrought that your name is known on every coast where there is a university or where there are scholarly men.
>
> You have won elsewhere high honors including the highest —membership in the National Academy of Science.
>
> Therefore, upon you, Clark Wissler, your University now confers the degree Doctor of Laws.

MEETINGS OF SOCIETIES

THE Société Géologique de France was founded March 17, 1830, and is planning to celebrate its centenary by a general assembly of geologists in Paris on Monday, June 30, 1930, to which delegates will be invited from all parts of the world. Among its long list of distinguished presidents the Society numbers Cordier, Alexandre Brongniart, Constant Prévost, Dufrénoy, Elie de Beaumont, Alcide d'Orbigny, Daubrée

Albert Gaudry, Hébert, De Lapparent, Mallard, Marcel Bertrand, Michel-Lévy, Munier-Chalmas, Emile Haug. It is now under the presidency of Dr. Pierre Termier, a member of the ancient Academy of Sciences in Paris. Meanwhile, a jubilee volume is being prepared to which contributions have been invited of geologists and palæontologists representative of various geological societies and academies. As Senior Geologist of the United States Geological Survey and Gaudry Medallist of the Société Géologique de France, Prof. H. F. Osborn is contributing to the jubilee volume a memoir entitled "Ancient Vertebrate Life of Central Asia. Discoveries of the Central Asiatic Expeditions of the American Museum of Natural History in the Years 1921–1929."

THE Section of Biology of the New York Academy of Sciences held its annual demonstration in Education Hall of the American Museum on Monday evening, December 9. Forty-one investigators presented demonstrations which ranged from the structure and functions of single-celled animals to the anatomy of man. The demonstrations were examples of current research work being carried on in Columbia University, New York University, College of the City of New York, Rockefeller Institute, Flower Hospital, and other institutions of the city. Nine of the demonstrations were presented by American Museum biologists, who reported the results of the original investigations on the physiology and embryology of salamanders, embryology of fishes and lizards, the habits of insects and salamanders, the adaptive modifications of worms, and evolutionary problems in birds. The Museum members taking part in the program were: Doctors Lutz, Miner, Murphy, Gudger, Noble, Mr. Brady and Misses Richards and Teale.

SCIENCE OF MAN

OUR research associate, Dr. Robert Broom, in a recent letter, gives his opinion of *Australopithecus*.

I was rather surprised to find that the scientific world has apparently quietly dismissed any claims the Taungs Anthropoid Ape might have to be near the point of the origin of Man, and that the general opinion seems to be that it is only a Chimpanzee. Holding, as I do, that *Australopithecus* is not a Chimpanzee, and that it is an Anthropoid Ape very much nearer to the form which gave rise to Man than either the Chimpanzee or the Gorilla, and that it is thus by far the most important fossil ever discovered, I feel I must do what little I can to prevent a final decision which I am convinced is wrong. In *Australopithecus* the incisors are not directed forwards as in the Gorilla and Chimpanzee, but almost downwards as in Man. The canine is relatively small, and in shape much nearer to that of Man than the canines of any of the living Apes. *Australopithecus* was a cliff and plains-frequenting being like the Baboon of today. We can be quite certain that it was not a forest animal from the geological structure of the rocks and caves at Taungs, and from the fossil-remains associated with it. And as it was, we have good reason to believe, from a cliff and plains-living pro-Gorilla that mankind arose, I think there is much to be said in favour of *Australopithecus* being very near to the origin of the human stem and possibly even being the very ancestor.

NEW BOOKS

Carl Akeley's Africa. By Mary L. Jobe Akeley. Dodd, Mead & Co., N. Y. City. 1929.

AS the steam-shovels dig alongside the American Museum, Carl Akeley's vision of an African Hall is coming true. This great dreamer spared no efforts to give his plans solid form; and before the walls have begun to rise, many of his masterpieces stand ready to take their places in the new building, and the work is being carried forward by a staff of experts trained in the Akeley school.

The story of Akeley's life, as related in his *Brightest Africa*, is fittingly completed in Mrs. Mary L. Jobe Akeley's recent book, *Carl Akeley's Africa*. The African Hall had become a certainty, the men were trained who would complete its exhibits, but their leader could not relax. Another expedition would assure a proper setting for the Gorilla Group and obtain material for other examples of the splendor of mammalian life in eastern Africa.

This—to the world's sorrow—was his last adventure, ending so tragically, yet so magnificently. The story is recorded in full by Mrs. Akeley's loving pen, with a depth of feeling that is best appreciated by those of us who saw the Akeleys at their devoted and strenuous task in Africa. The pace was a hard one, it began to tell on Akeley; but when the time came to turn toward the sanctuary which his own efforts had gained for the Kivu gorillas, there was no slackening. Nothing could weaken the urge to revisit the most glorious spot in all Africa.

We may wish he had spared himself a little, that he had not purposely chosen the very worst season because of its opportunities for distant views in Leigh's painting of the scenery. But we can only be thrilled by the indomitable courage that carried him upward into the cold and misty home of the mountain gorillas.

Mrs. Akeley's book is steeped in the love of Africa so familiar to naturalists who have worked there. How fortunate that, as her husband's biographer, she served also as his able assistant throughout this last long trek. For my part, her book gives me the illusion of being with the party as they toiled up the forested slopes into the romantic retreat of our friends the gorillas. It reawakens the sadness I experienced as I knelt beside Carl Akeley's grave; and I can bear witness to the loving care bestowed on the last resting place of a pioneer in a noble cause. It will be a shrine visited by many a naturalist in years to come.—J. P. CHAPIN.

AUTHORS IN THIS ISSUE

The cover design for this issue of NATURAL HISTORY is from a painting by **Arthur A. Jansson**, of the American Museum's department of preparation. The giant panda is one of the rarest of animals, and so far as any records go, the first one ever seen alive by white men was the specimen obtained by Kermit and Theodore Roosevelt for the Field Museum of Chicago. Skins of these animals have occasionally been brought out by natives or by missionaries or travelers who had obtained them through natives, and the American Museum has such a skin. Accurate pictures of the animal, however, are almost unknown, and Mr. Jansson's painting, based on Mr. Kermit Roosevelt's photographs and on other data including a smaller painting by Carl Rungius, is a highly unusual and very valuable representation of this raccoon bear of the borders of Tibet.

Kermit Roosevelt, the author of "In Search of the Giant Panda" has long been interested in exploration. In 1909–10 he accompanied his father, Theodore Roosevelt, on a hunting trip in Africa; and in 1914 on an exploration trip on the "River of Doubt" in Brazil. Since then he and his brother Theodore have together organized and carried out several scientific expeditions. During the course of these they collected for the Field Museum in Chicago, specimens of the Thian-shan ibex and Littledale sheep with world-record horns: they also collected *Ovis poli* in Turkestan for the Field Museum.

Both **Gertrude Sanford** and **Sidney Legendre** have interesting records as sportsmen, Miss Sanford having hunted in Tanganyika and Mr. Legendre having collected tigers in Indo China previous to the Abyssinian expedition. The need of the American Museum for specimens of nyala for a habitat group proved a stimulus to them to secure the necessary material. The first installment of their story of this trip appears in this issue of NATURAL HISTORY under the title "In Quest of the Queen of Sheba's Antelope."

It has been very largely due to the generosity of **Arthur S. Vernay** that an Indian hall is being established as a part of the American Museum. During the winter seasons of the past nine years, he has, with Col. J. C. Faunthorpe, collected specimens of the fauna of India, all of which he presented to the American Museum. To secure specimens of the almost extinct Indian lion has always been his great ambition, but it was only after three years of constant effort that permission to collect them was finally granted. In his article "The Lion of India," Mr. Vernay describes his experiences in obtaining this rare prize.

G. Kingsley Noble is curator of the department of herpetology and experimental biology of the American Museum. The problem of the origin of species is being attacked experimentally in many laboratories and Dr. Noble writes in his article "What Produces Species?" on the subject from the viewpoint both of the laboratory and field man. Almost every naturalist who studies animals in the field has been confronted with the question, How do species arise? Geneticists have apparently answered this question and Doctor Noble shows how the data of the geneticist agrees fully with that of the field naturalist.

Clark Wissler, curator-in-chief of the department of anthropology at the American Museum and author of "The Universal Appeal of the American Indian" in this issue, is already well-known to the readers of NATURAL HISTORY through his many contributions to its pages. Doctor Wissler has devoted the greater part of his life to the study of man, and has become internationally known as an authority on the American Indian, particularly the Indians of the Plains. His latest book, *An Introduction to Social Anthropology* is just off the press.

Leonard W. Kephart, the author of "The Grass Trails of East Africa" has been in the Bureau of Plant Industry at Washington, D. C., for sixteen years, during most of which time he has been studying the culture and use of forage crops in the United States. When in 1927, it was decided to send an expedition to East Africa, he went and thus became the first grass seed collector for the United States Government. During recent years the policy of the Bureau has been to send out specialists for certain kinds of plants rather than to send general collectors as was the custom some years ago. In this way more than a dozen Department men have become plant explorers since the war.

Facts concerning other authors have appeared in former issues of Natural History

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NEW MEMBERS

SINCE the last issue of NATURAL HISTORY, the following persons have been elected members of the American Museum, making the total number 11467

Life Members

Mesdames ANNIE C. ATWOOD, J. J. KERRIGAN.
Messrs. WM. SHIRLEY FULTON, H. L. GOODHART, ANTON G. HARDY, H. C. JACKSON, GORDON MACDONALD, JOHN MAGEE, ALONZO K. MARSH, JAMES A. SMITH.

Sustaining Members

Messrs. WILLIAM A. M. BURDEN, CHARLES E. DUNLOP, SAMUEL S. DURYEE, CHARLES C. GOODRICH, GEORGE W. HILL, WAYNE JOHNSON, PERCY H. JOHNSTON, ROBERT CRAIG MONTGOMERY.

Annual Members

Mesdames THOMAS M. ALEXANDER, GRENVILLE T. ANDERSON, THEODORE H. BANKS, LOUIS G. BISSELL, J. NORMAN CARPENTER, CLEMENTINA DWORSKY, LEO E. FRANK, HENRY HOLT, JAMES H. JOWETT, ALLAN H. KERR, W. THORN KISSEL, SHEPARD KRECH, JULIAN LAMAR, DAVID T. LAYMAN, JR., D. MILBURN, ELMER L. RICE, HENRY STEELE ROBERTS, WILLIAM ROOS, HELEN MANNING SCHWARZ, ALEXANDER B. SIEGEL, EDGAR STIX.
Misses ANGELINE R. BARRETT, BERTHA MCL. DOW, HELEN B. GERE, MARY A. HANCKEL, PAULINE LEIPZIGER, MARY L. SHIPMAN, GLADYS TERRIBERRY, ANTOINETTE WILSON.
Professor A. J. GOLD FORB.
Doctors JAMES T. HARRINGTON, FORBES HAWKES, ARCH H. MORRELL, PAUL COLHOUN MORTON.
Hon. SAMUEL W. MOORE.
Messrs. H. W. ANDREWS, CLEMENT B. ASBURY, R. F. BAKER, CHAS. W. BORGMAN, JAMES E. CORSA, HAROLD COWAN, CHARLES M. DELAND, JR., FREDERICK S. DELLENBAUGH, ROBERT G. DORT, HENRY M. EARLE, CHARLES ERICSON, FREDERICK, S. FALES, EDWARD C. FOGG, J. TAYLOR FOSTER, LYTTLETON FOX, AUGUST FRANZEN, VINTON FREEDLEY, EDWARD W. FREEMAN, STANLEIGH P. FRIEDMAN, LOUIS F. GARLIN, ALBERT H. GORDON, HAROLD DUDLEY GREELEY, ARTHUR J. GRYMES, HOWARD S. HADDEN, F. V. HAMMAR, C. H. HAND, JR., WALTER T. HART, PAUL H. HARWOOD, KEITH HENNEY, MELLINGER E. HENRY, PAUL H. HUDSON, EDWARD G. KENNEDY, H. MAYNARD KIDDER, ARKLAY KING, C. DALY KING, GARRETT B. KIP, JONATHAN T. LANMAN, J. T. LANMAN, JR., STANLEY R. LATSHAW, CARL PHILIP LENZ, PHILIP LESERMAN, JR., F. M. MACDOWELL, LAWRENCE H. MARKS, ANTHONY L. MCKIM, ARTHUR V. B. MENKEN, LEVERETT S. MILLER, L. OWEN MINER, HENRY M. ORNE, GEORGE ROBERTS, RUDOLPH SAUER, LOUIS V. STERLING, E. L. TANNER, JR., ROBERT R. THIEN, RALPH W. WILSON.

Associate Members

Mesdames L. F. BANGLE, MATTIE M. BETTS, GEORGE E. BEVANS, RALPH E. CLARK, GEORGE E. HALLENBECK.
Misses ELSIE D. CANAN, BERTHA DAMHEIM, HELEN W. GILLETTE.
Doctors WILLIARD BARTLETT, FRANK V. MCCONKEY.
Comdr. DELOREST J. D. NOBLE, R.N.
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